NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, NOVEMBER 1, 1900.

A NEW FRENCH FORESTRY TEXT-BOOK.

Les Forêts. Par L. Boppe, Directeur honoraire de l'Ecole Nationale des Eaux et Forêts de Nancy, et Ant. Jolyet, chargé de cours à l'École. Pp. xi. + 488. (Paris: J. B. Baillère et Fils, 1901).

WITHIN the last ten years the course of instruction at Nancy has been considerably modified. The school is attended by some foreign students, who, as well as a few occasional private French students, are admitted without any regular examination. Formerly, students intended for service in the State and Communal forests of France passed a preliminary competitive examination in the subjects usually taught at a Lycée, including physics and chemistry. A knowledge of botany, entomology and geology, however, was not required of them, these subjects being taught *ab initio* at Nancy; in those days the marks obtained for forestry unduly overshadowed those given for natural history, and only a few devoted naturalists were to be found among French forest officers. Forestry teaching at Nancy also was much too dogmatic, and not sufficiently based on experimental results.

At present, French forest students who are intended for the service of the State come from the *Institut National agronomique*, and must obtain a diploma there before being admitted to Nancy. About eighty students enter the Institut agronomique annually, while the number of State students at Nancy is limited to twelve per annum, the last twelve men admitted to Nancy standing 1, 3, 6, 7, 9, 10, 15, 21, 24, 26, 39 and 48 at the final examination of the Institut agronomique. Nancy students thus at present possess a considerable knowledge of agriculture and experimental natural science; they also get pecuniary allowances from the State, so that admission to the French forest service is open to a wide field of French citizens, and is not confined, as are some of our own public departments, to a restricted class of men, who have sufficient means to pay the high cost of training involved, this restriction injuriously affecting the intellectual standard of the departments.

Forestry teaching at Nancy has responded admirably to the higher attainments of the present class of students, and it is a real pleasure for one who studied there nearly thirty years ago to note the excellence of this new text-book of sylviculture.

In it a forest is described as a complex organic whole, composed of a porous and friable humous soil, covered with dead leaves and moss, wherever the shade is too great for vegetation other than saprophytes; where, however, the mature crop of trees has been thinned or cleared with a view to natural regeneration, the soil is soon overgrown with grasses or other herbaceous plants, as well as brambles, bushes and shrubs, which, together with the young plants of the valuable forest species, form a complex mass from which saplings, poles and trees gradually emerge, and compose a new crop, either as coppice or high forest. This evolution of a new crop from an old one requires considerable skill on the part of a forester, and it is only by carefully observing and following nature that success is obtained. Each forest species makes different demands on soil and climate and requires in its young state various degrees of protection against hostile meteoric influences, injurious plants and animals.

In France natural regeneration, either by seed or by coppice shoots, is the chief means of reproducing a forest, and human interference with the growing forces of nature is reduced to a minimum. The chief classes of French indigenous high forests, reproduced by seed, consist of oak, beech or silver-fir; maritime pine in Gascony; larch and spruce in the Alps, the latter also growing in the Jura with beech and silver fir; *Pinus sylvestris* (for which our name of Scotch pine is far too local, and as a substitute for which I would suggest the name red pine) is indigenous in France only in mountainous regions, but has been extensively planted on poor sandy soils in the lowlands. There are extensive coppices of mixed underwood with oak and other standards, and of holm oak with Aleppo pine standards, in Provence. The holm oak (*Quercus Ilex*) prefers calcareous soils, and is replaced in the south of France, on siliceous soils, by the two very valuable cork oaks (*Quercus Suber* and *Q. occidentalis*), the latter differing from the former by its habitat near the Bay of Biscay, and by its taking two years to mature its

acorns. Both these oaks are usually grown isolated in vineyards for their cork. *Quercus Tozza* is restricted to the south-west of France, where extensive coppices of it are grown for fuel. Hornbeam is abundant in the north-east, chiefly in coppice-with-standards; its abundance in Epping Forest probably dates from the time when England was connected by land with the Continent. Other species of forest trees, such as ash, alder, sweet-chestnut, sycamore, willows, poplars, birch, lime, elms, &c., are either confined to special soils over small areas, or disseminated in forests of the principal species that have been already mentioned. Maps are given in the text-book showing the geographical distribution of the principal trees.

There is an excellent chapter on the action of trees on one another, and on the value of shade-bearing species, such as beech, as auxiliaries to the more valuable light-demanding trees, such as the pedunculate and sessile oaks, the former being chiefly grown in the lowlands on deep, moist or even wet soils, as standards over coppice, and the latter with beech in high forests on the hills. Both these oaks, as well as the holm oak, are also extensively grown in coppice woods, chiefly for their bark, as tanning material.

A good account is given of the nature of forest soil, and the necessity of preserving the dead leaves to form humus is strongly insisted on. It has been proved by Grandeau and Henry, two of the Nancy professors, that besides serving as food for earthworms and other organisms, the activity of which keeps the soil porous, friable and superficially rich in nutritive mineral matter, dead leaves fix atmospheric nitrogen to the extent of 12–20 lbs. per acre annually. To deprive the forest of its dead leaves is like robbing a farm of its dung.

The evolution of a crop of trees by natural regeneration is well described, the account of coppice-with-standards being probably more complete than in any other text-book. The cultural methods to be followed when once the new crop is established are also well explained and chiefly consist of cleanings and thinnings. The authors are strongly opposed to the pruning of forest trees, and consider that drainage is very rarely required. Their remarks on these points should be read. Among sylvicultural systems yielding even-aged high forest (*futaie regulière*), the clear-cutting system (*procédé par coupe unique*), which is so extensively followed in parts of Germany for crops of spruce or red pine, is employed in France only for maritime and Aleppo pines. The cones of the pine trees adjoining a clearing produce abundance of seed, which at once stock the ground, provided the felled material is rapidly removed, and the seedlings of these trees are so vigorous and hardy against drought, that they soon dominate the mass of bushes and weeds springing up around them.

The system under which a mature crop is gradually removed (*procédé par coupe successive*), termed by Dr. Schlich shelter-wood compartment system, is that commonly employed in French high forests. It gives admirable results in oak and beech woods, but its application to silver-fir is not so successful, as silver-fir grows better when the larger trees are surrounded by an irregular undergrowth of beech and silver-fir.

The selection system (*jardinage*) similar to that employed in the Chiltern Hills for beech, is much used in France for silver-fir, chiefly in communal and private forests, and in State forests in mountainous districts, where it affords the best protection against denudation of the slopes.

About 70 pages of the book are devoted to an accoun of possible injuries to the forest by men, animals, plants and meteoric influences. This really constitutes the subject of Forest Protection, and is usually dealt with apart from sylviculture in German and English forestry text-books. One hundred and sixty pages at the end of the book treats of artificial reproduction, and resemble the account of sowing and planting usually given in other good sylvicultural works. This part of the book terminates with an account of exotic trees, the introduction of which is not viewed in France with nearly so much interest as with us, although the subject is very judiciously treated in the present volume.

The book is profusely illustrated by reproductions of photographs chiefly taken by Nancy students during their summer tour; it forms a highly valuable contribution to forestry literature, and is certainly the best account of French sylviculture that has yet appeared. There is a good table of contents, but no index, the omission of which is to be regretted.

W. R. FISHER.

TOPOGRAPHIC SURVEYING.

Topographic Surveying. By Herbert M. Wilson. Pp. 884. (New York: Wiley and Sons. London: Chapman and Hall, 1900.)

MR. WILSON'S book is comprehensive, clear and well illustrated, and contains much information of practical use to the surveyor and explorer, which is not usually found in works on surveying and map-making. Its author is a member of the staff of the United States Geological Survey, and his remarks on the methods and processes of that Survey are therefore of special interest.

The Geological—which is virtually a topographical—Survey of the United States is a work of great magnitude, and the manner in which the staff engaged upon it have met the numerous technical, transport and other difficulties that have arisen during its progress is most interesting. It was laid down as a general principle that no part of the country should be surveyed in greater detail, or at greater cost, than was necessary for the purposes which the resultant map was intended to subserve. This involved a rapid and economical survey of a vast extent of country within reasonable limits of error. The method adopted

"consists of a combination of trigonometric, traverse and hypsometric surveying to supply the controlling skeleton, supplemented by the 'sketching in' of contour lines and details by a trained topographer. In this method the contour lines are never actually run out, nor is the country actually cross-sectioned."

The instruments used vary with the nature of the country. For geodetic work, a combination transit and zenith telescope of special pattern (p. 726) has been found most convenient. Primary bases are measured with steel tapes, with an average probable error of 1/300,000, in from seven to ten days, at a cost of 20*l*. to 40*l*.; whilst the bases of the U.S. Coast and Geodetical Survey have

a probable error of 1/1,000,000 to 1/1,500,000, take from two to six months to measure, and cost from 500*l.* to 2600*l.* The observations for the primary triangulation are made with an 8-inch direction theodolite, the average rate and cost being six stations per month and 3*s.* 7*d.* per square mile, and the average probable error of the triangulation 1/40,000. The averages of the Geodetic Survey are three-fourths of a station per month, from £2 to £6 per square mile and the probable error 1/150,000. For filling in the detail the essential instruments are the plane-table and telescopic alidade (p. 156). The horizontal distances are obtained, according to circumstances, by triangulation with the plane-table, by stadia and odometer measurements, by chaining, and by pacing. The altitudes are dependent upon primary lines of levels run with a precise spirit-level (p. 328), and having a probable error in feet $= \cdot 02 \sqrt{\text{distance in miles}}$; on angles of elevation and depression at the principal trigonometrical stations, on secondary lines of spirit-levels and on aneroid observations. The topographical features are represented on the map by contour lines sketched by eye with the assistance of an aneroid, and great importance is attached to the quality of the sketching. This depends upon the artistic and practical skill of the topographer, or upon his ability to make correct generalisations, and decide upon the amount of detail which should be omitted or preserved so as to bring out, on the selected scale, the predominant features of the country surveyed. In this work, as the author justly remarks, great proficiency "can only be attained after years of experience." He also rightly holds that the topographer should have a sufficient knowledge of geology and physiography, or of the "origin and development of topographic forms," to enable him to appreciate the features which he is sketching and to represent them intelligently on his sketch.

Mr. Wilson's book is, however, very far from being a simple manual for the use of the Geological Survey. It deals with every description of survey, and treats each fully. Part i. contains much useful information on the different classes of survey. An interesting description is given of the survey of Baltimore on a scale of 1/2400, which corresponds nearly to the 25-inch scale of the Ordnance Survey; but if the figures given in the table, p. 107 (Baltimore 814*l.* per square mile, Ordnance Survey 59*l.*), are correct, the cost would be considered prohibitive in this country. The remarks on geographic and exploratory surveys are good, and Mr. Johnson's excellent plane-table sketch, which is given as a specimen of an exploratory survey (p. 91), may well serve as a model for sketchers. Military surveys are correctly defined as having for their object "the representation of the natural and artificial features of the country with the maximum exactitude consistent with the greatest rapidity of execution." The concluding chapter is a well illustrated memoir on the relations of geology to topography, and on 'earth sculpture,' or the constructive and destructive processes by which existing topographical features have been formed. The importance of a knowledge of these subjects to the topographer and cartographer is clearly pointed out. A valuable addition to the chapter is a glossary of all geographical and topographical descriptive terms in common use in the United States, which, pending the compilation of a similar list for the United Kingdom, will be found useful in this country.

In Part ii. the instruments and methods employed in the measurement of horizontal distances and in plane surveying are clearly described and explained. Chapters vii. and viii. on plane-tables and alidades, and chapters xii. and xiii. on stadia and angular tachymetry, deserve the attention of surveyors in England, where stadia measurements, which give results over rough ground as good as those with the chain, are little known. In another chapter the author describes photo-surveying methods, which are much in favour in Canada, and points out their limitations and the conditions under which they can be advantageously employed. Part iii. deals with instruments and methods for the determination of altitudes. The American spirit levels and levelling staves are of better pattern than those in use on our Ordnance Survey, and the accuracy of the principal lines of levels is greater than that of the similar lines in Great Britain. In Part iv. the author explains the various kinds of map projections, the methods of representing hill features and the construction of relief maps. He very rightly lays down that the cartographer should be "possessed of such actual knowledge of map-making as is only gained by practical experience in field-surveying," and that the topographer should have a general knowledge of projections and map construction. The difference between the principal methods of representing ground is well brought out; that by hachures is happily characterised as "a graphic system with a conventional element," and that by contours at close intervals as "a conventional system with a graphic element." Wax and clay mixed with glycerine are considered the best materials for modelling, and it is pointed out that a modeller should have a good knowledge of topography. Parts v. and vi., "Terrestrial Geodesy" and "Geodetic Astronomy," are clearly written and well supplied with tables; and the latter contains a chapter on "Photographic Longitudes." In Part vii. the surveyor in unsettled country will find many excellent hints as to camp stores and equipment, pack transport, medicines, clothing and photography.

In conclusion, it may be added that the book contains 884 pages, 62 tables of various kinds, 205 excellent illustrations, and a most useful index. It would in some respects have been more convenient if it had been published in two volumes.

C. W. W.

THE ETHNOGRAPHY OF BRITISH COLUMBIA.

Memoirs of the American Museum of Natural History. Vol. II. *Anthropology.* i. *The Jesup North Pacific Expedition.* iv. *The Thompson Indians of British Columbia.* By James Teit. Edited by Franz Boas. (1900.)

IMPORTANT results were looked for from the Jesup North Pacific Expedition, and the realisation has not belied the expectation. Thanks to the intimate knowledge of Mr. James Teit of their language, customs and beliefs, we now have a remarkably detailed and complete description of the Upper and Lower Thompson

Indians, especially as this is supplemented by the valuable work done by Dr. G. M. Dawson, Dr. Franz Boas, Mr. C. Hill Tout, and others on these or allied tribes of British Columbia, under the auspices of the British Association for the Advancement of Science.

The Upper Thompson Indians live in the valley of the Thompson River, while the Lower Thompson Indians dwell on the Fraser River. They appear to have decreased to one third since the advent of the white man in 1858. The birth-rate is about equal to the deaths, but there is great mortality among young children; at the present time the population in some places seems to be about stationary, or is slowly increasing. The Lower Thompson Indians are quieter and steadier than the people of the upper division, but are slower and less energetic; they are also better fishermen and more expert in handling canoes, while the Upper Thompson Indians are better horsemen.

In this copiously-illustrated memoir Mr. Teit has carefully described the handicrafts of the Thompson Indians. Most of their implements were made of stone, bone, wood, bark, skins, matting or basketry. Work in stone, bone and wood was done by the men, while the preparation of skins, matting and basketry work fell to the share of the women. There was a certain amount of division of labour, as workmen skilful in any particular line of work exchanged their manufactures for other commodities.

The various kinds of habitations and clothing and ornaments are fully described, and the changes that have ensued since 1858 are recorded. For example, beads and dyed porcupine quills were largely used for embroidery before that date; but these were soon replaced by embroidery done in silk thread, and most of the patterns wrought at the present day are copies of the white man's patterns. Full accounts are given of the arts, of subsistence, varieties and preparation of food, hunting, fishing and the like, as well as of travel, transportation, trade and warfare.

The games and pastimes of adults and children are carefully dealt with, and this account usefully supplements what has been previously recorded for similar tribes. It is a pity that the author describes as a "bull-roarer" quite another kind of toy, which Culin calls a buzz; the latter is an oblong or circular piece of thin wood, with two holes near the centre through which a string is passed. It is widely distributed among the Indians of North America, and, so far as is known, has little in common with the true bull-roarer. The smaller boys and girls play "cats' cradle," and we are told they make many forms such as the "beaver," "deer," "man stealing wood," &c. Fig. 270 illustrates two of these puzzles, one—"dressing a skin"—is very difficult to follow; the second—"pitching a tent"—is simpler, and, strangely enough, is precisely similar to the "fish-spear" string puzzle of the Torres Straits Islanders.

Very interesting and instructive are the accounts given of the social organisation and festivals of the people, and of the customs relating to birth, childhood, puberty, marriage and death. Their religion is fully dealt with, and it is worthy of note that no totemism is recorded for these people; but each individual has a guardian spirit, which was acquired during the puberty ceremonials. Only a few shamans inherited their guardian spirits without such ceremony from their parents, who had been particularly powerful. The guardian spirits of these parents appeared to them, uncalled for, in dreams and visions. The moral code is excellent, and the young people are often admonished and advised. It is good to be pure, cleanly, honest, truthful, brave, friendly, hospitable, energetic, bold, virtuous, liberal, kind-hearted to friends, diligent, independent, modest, affable, social, charitable, religious or worshipful, warlike, honourable, stout-hearted, grateful, faithful and revengeful to enemies. Various legends are noted, and there are the usual constellation myths; but several of the stars or constellations have not been identified, so that no comparative study is possible. The traditions have been published in full by Mr. Teit in the *Memoirs of the American Folk-lore Society*, vol. iv.

The memoir concludes with a chapter on art and a summary, both by Dr. Boas. The decorative art of the Thompson Indian is very crude; form and decoration have no intimate connection, comparatively few designs are primarily decorative, their fundamental idea being symbolic. For this reason, by far the greater number of designs may be described as pictographs rather than as decorations.

The Thompson Indians are in appearance and culture a plateau tribe, influenced, however, to a great extent by their eastern neighbours, to a less extent by the tribes of the coast. Their whole social organisation is very simple, and the range of their religious ideas and rites is remarkably limited when compared with those of other American tribes. This may be one of the reasons why, in contact with other tribes, the Salish have always proved to be a receptive race, quick to adopt foreign modes of life and thought, and that their own influence has been comparatively small.

If all the field-work done by the numerous investigators on the staff of the Jesup North Pacific Expedition is as complete and workmanlike as the present memoir, and is published in similar first-class style, the result will be a dignified monument to the ability of American anthropologists and to the enlightened munificence of Dr. Jesup.

ALFRED C. HADDON.

OUR BOOK SHELF.

Lubrication and Lubricants. By L. Archbutt and R. M. Deeley. Pp. xxiv + 451. (London: C. Griffin and Co., Ltd., 1900.)

MESSRS. ARCHBUTT AND DEELEY have, in this treatise, placed before engineers and power users what is known of the theory and practise of lubrication.

Until the introduction of mineral oils as lubricants, there was comparatively little difficulty in obtaining good oils; the animal oils, such as sperm and lard, and the vegetable oils, such as castor, will keep a bearing cool, while mineral oils of the same apparent viscosity will allow it to heat. Oil users can only meet this difficulty by subjecting the oil to both chemical and mechanical tests.

The work is divided into two portions: the first treating of the theory of friction and the properties of lubricating substances, while the second describes the forms of bearings. The experiments of Mr. Beaucamp Towers and

Prof. Goodman have greatly added to our knowledge of the friction of bearings, as distinguished from the friction of rest, as found in our academic text-books. Messrs. Archbutt and Deeley have given a clear and extensive account of the modern ideas on friction.

Prof. Osborne Reynolds' monograph on the theory of friction is certainly one of the finest works on the subject, and it is to be regretted that his results are not more generally known to engineers.

The portion of the present volume relating to the chemical and physical examination of oils is thorough and copious; it will be of great service to chemists, but is somewhat beyond the range of most engineers, who, if they test their oils in any way, use the mechanical oil-testing machine, which, while useful in its way, does not give the same knowledge of the properties of a lubricating oil as does the chemical test.

We consider that oil-testing machines are only capable of yielding satisfactory results in the hands of experts, and then only when much time is expended in experiments. For research purposes they are most admirable, and from their use we have obtained practically all we know of friction; but for commercial testing we should prefer to rely on chemical and physical methods. The design and care of bearings are well described in the second part; all forms of bearings, from those of watches and clocks, cycles and large engines, are illustrated. We are pleased to see the block packings for piston rods described; the ordinary gland packing is certainly a defective form, and is the cause of considerable loss of power, even when no serious heating occurs. The omission of the system of forced lubrication seems a pity, especially as Messrs. Belliss and Morcom have applied it with so much success to their well-known quick-revolution engine. The work is, we consider, of the greatest value, and should be in the hands of both designers and users of all forms of machinery in which lubrication is important.

F. W. B.

Darwin and Darwinism, Pure and Mixed. By Dr. P. Y. Alexander. Pp. xii + 346. (London: Bale, 1899.)

THE decade which followed the appearance of the "Origin of Species" witnessed the publication of innumerable books and articles dealing with Darwin's great work. Although many of these were solid and valuable contributions to the literature of evolution and natural selection, the mass as a whole was characterised by the large proportion of works which proclaimed with the utmost confidence the opinions of authors unknown as naturalists. Men whose claim to a hearing was of the slenderest kind spoke with contempt of Darwin's reasoning powers or the rashness of his generalisations. After 1870 such works became rarer, and at the present day are, happily, quite uncommon. The book before us is, however, about as bad an example as can be found. It would not have been astonishing in 1869 to be told by a writer unknown as an original observer or thinker that "Mr. Darwin's capacities of thinking and drawing inferences from the immense masses of fact he had collected were not at all equal to his powers of observation, investigation and classification," or to observe the calm satisfaction in the following sentence: "My little effort will show that, wherever I have paid special attention to any department of natural history or natural science, I am apt to find Mr. Darwin at fault, more especially in his generalisations." The mildest statement which can be made about the publication thirty years later of such opinions by a Mr. P. Y. Alexander—author of "Heredity," "Parasitism," &c., notwithstanding—is that the work is an anachronism.

The literary style may be sufficiently exemplified by a couple of quotations from the "Argument of the Book."

"(2) Mr. Darwin went for essential *slowness* as a necessity of nature. He said in 'Origin' 'Nature can never take any great and sudden leaps.' When instances were presented to him of 'sudden leaps,' he tried to gloss it over, and always harked back on *slowness*" (p. ix.).

"(7) Mr. Darwin's notion that 'domestic animals which have long been habituated to a regular and copious supply of food *without* the labour of searching for it are more fertile than the corresponding wild animals,' shown by instance on instance to be *absurd*, opposed to the practice of all great breeders, and is, besides, physiologically impossible" (p. xi.).

It is probable that the reader who looks at such sentences as these will not feel sufficiently encouraged by the manner or matter to penetrate further, even though "the most absolute refutation of poor Darwin's fallacy" should be later on established, to the entire satisfaction of the author.

E. B. P.

Electric Wiring Tables. W. P. Maycock. Pp. iv + 144. (London: Whittaker and Co., 1900.)

MR. MAYCOCK'S pocket-book of tables should prove very useful to those electrical engineers whose work consists solely of wiring and fitting. It contains in a very convenient form tables of all the quantities likely to be wanted in such work, and has the advantage of being quite up to date, the values in the tables of the safe currents, resistances, &c., of copper conductors being calculated on the basis of the recommendations of the Institution of Electrical Engineers Committee on Copper Conductors, which only made its report at the beginning of this year. It is, perhaps, a disadvantage of the pocket-book that it is so limited in its scope, and we are inclined to think that it would appeal more strongly to the particular class of electrical engineers for which it is designed if more general information were included. A summary of the fire insurance rules should certainly be inserted, and it would be useful if some idea were given of the approximate costs of wiring on the different systems alluded to in the section on "Systems of Wiring." Some of the tables are simply "Ready Reckoners"; for example, the tables of "Price and Length of Conductors" give the prices of different lengths of conductors calculated from the price per yard, and would apply equally well to wood-casing and metal-piping, a fact which should be indicated in the title of the table. The table giving the current taken by different numbers of lamps working at different pressures and different efficiencies is a very useful one, particularly now that high-efficiency lamps are being brought forward. The same can hardly be said of the list of towns supplying on the alternate current system, since no details are given as to pressure and frequency. The usefulness of the pocket-book would be considerably increased by the addition of an index.

Raggylug, the Cottontail Rabbit; and other Animal Stories. By Ernest Seton-Thompson. Pp. 147. (London: David Nutt, 1900.)

MR. SETON-THOMPSON'S success as a writer about animal life lies in the fact that he endows his subjects with human faculties and sympathies. It is, of course, illogical to make animals consider everything from an anthropomorphic point of view; but, after all, this is the only point of view which it is possible for us to conceive, and there is no objection to occupying it, provided that its artificial nature is borne in mind. By following this method, Mr. Seton-Thompson's animal stories have a sentimental interest, and they create a love of animate nature in the minds of all who read them. There are four stories in the present volume, and each is an instructive as well as interesting narrative of animal life. Children will read the stories with delight, and adults will find their sympathies awakened by them.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Leonids—a Forecast.

IN the *Proceedings* of the Royal Society for March 2, 1899 (vol. lxiv. p. 403), will be found an account of the perturbations suffered since 1866, November 13, by the Leonids which in that month intersected or passed close to the earth's orbit. This position in the meteor stream may be called station A (Fig. 1).

We have since investigated the principal perturbations affecting two other points in the stream, viz., the station Z, which intersected the earth's orbit 360 days earlier, *i.e.* in November

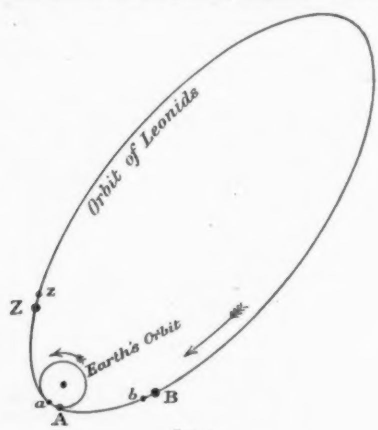

FIG. 1.

1865, and the station B, which intersected the earth's orbit 360 days later, *i.e.* in November 1867.

We therefore now know the principal perturbations which during the last revolution of the meteors have affected three points, Z, A and B, situated along an orbit (Adams's orbit) which, at the commencement of the revolution, lay within the stream.

The full results of the investigation will not be ready for publication till after the time when the Leonid shower of this year is due, and on this account it has been thought expedient

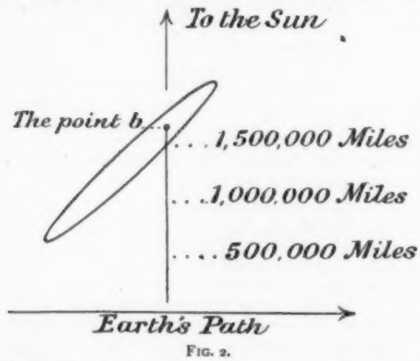

FIG. 2.

to publish beforehand such of the results as have special reference to it.

A point in the stream which in 1867 lay along Adams's orbit between A and B, but nearer B, and which we may call the point *b*, will this year reach its descending node simultaneously with the earth. This will happen approximately on 1900, November, 15d. 3h. Greenwich mean astronomical time.

Unfortunately, the orbit of a meteor situated near point *b* in the stream, instead of intersecting the earth's orbit as it did in 1867, will now pierce the plane of the ecliptic in a point which lies about 0·018 nearer the sun. Now, 0·018 of the earth's mean distance from the sun is 1,674,000 miles; so that, of the meteors which in 1867 intersected the earth's orbit, those which will come nearest to the earth in the present year will not approach it nearer than a million and six hundred thousand miles.

It is known from the duration of the great showers that the width of the ortho-stream, if measured in the direction which is parallel to the earth's path, is only about 300,000 miles; but there is reason to believe that the Leonids entered the solar system under conditions which have made the section of the stream much longer than it is broad, so that its trace upon the plane of the ecliptic is something like what is represented in Fig. 2. The longer axis of this cross section lay originally along the radius vector from the sun, but perturbations have acted on the Leonids for nearly 1800 years of such a kind as have probably caused the section of the stream to incline in the direction represented in the figure.

If the section is long enough to reach the earth's orbit, we shall have a great meteoric shower this year. It is, besides, just possible that a sinuosity in the stream may so displace a part of the section as to bring it sufficiently far out. But neither of these seem likely to have happened; so that the present investigation does not raise any hope of a great shower this year.

If, contrary to our expectation, the axis major of the section proves to be long enough to reach the earth's orbit, the consequent shower of ortho-Leonids is likely to occur several hours—possibly more than a whole day—earlier than

1900, November, 15d. 3h.

The number of hours by which it will precede that epoch depends upon the angle which the axis major of the section makes with the radius vector from the sun—an angle which is at present unknown. If there is this year a shower of ortho-Leonids, the time at which it occurs will enable us to determine this important datum.

Station *a* in the stream (see Fig. 1) intersected the earth's orbit in 1866, but after completing a revolution it passed the earth in November of last year at a distance of some 1,300,000 miles; and *z*, the corresponding point for the preceding year, which also intersected the earth's orbit in 1865, was on its return distant from the earth in November 1898 by about 960,000 miles. It thus appears that the displacements of the meteoric orbits which have been brought about by the perturbations of the last thirty-three years suffice to have prevented the meteoric orbit from now intersecting the earth's orbit. This accounts for our not having had any great shower in either of the last two years, and unfortunately the conditions seem still more unfavourable in the present year.

Nevertheless, as there is always a possibility that one or other of the contingencies mentioned above may carry a part of the ortho-stream out as far as the earth, and as we have no means of ascertaining whether those contingencies have arisen, it is desirable that preparation shall be made for adequately observing the shower, if it should unexpectedly come.

The perturbations during the last revolution, which have for the present carried the ortho-stream of Leonids so far from the earth's orbit, belong to the class of perturbations which act at different times with equal effect in opposite directions; so that there is reasonable ground for expecting that further perturbations must at some future time bring this remarkable stream back to the earth's orbit. It would be possible to ascertain when this will happen, by an investigation carried over a sufficient time forward upon the same lines as those which we have pursued.

G. JOHNSTONE STONEY.
A. M. W. DOWNING.

October 24.

Examinations in Experimental Science.

YOU occasionally do us, who are humble teachers of Elementary Science in schools, the very great kindness of giving us, through your columns, the chance of reaching the ears of those eminent men who are your frequent contributors, and who examine our pupils. Will you, in the interest of that real science teaching, so often advocated in your columns, allow me such a chance now? I will be as brief as possible. In common with a few individuals and many public bodies, I have spent a very large amount of time, money and labour in introducing the teaching of practical physics into my school, and trying to see that it shall be of the best kind possible, and I am prepared to do more.

But really there must be some agreement between us and the said eminent men as to what practical science is when the examination paper is composed.

May I give my illustration? The Cambridge Local Syndicate have introduced Elementary Experimental Science, three papers, into their junior syllabus. The other day I set two of these three papers for 1899 to a number of boys who had had a most careful experimental training in the matter of the syllabus. They made wry faces over it, and were heard to remark afterwards that they did not see what it had to do with the experiments they had been doing. On marking the papers I found that the best boys, really very good and careful experimenters and observers and good draughtsmen, for boys, barely reached forty per cent. of the marks. The same papers were set to a sharp boy of the same age who had done no experiments, but had been through the same subjects, mechanics, hydrostatics, and heat, in the old way, viz., text-book and problems. *He scored nearly full marks on all the physics questions.*

The fact is, that except for the heading, "Experimental Science," there is nothing in two of these papers to indicate that they are set to candidates whose knowledge is based on and drawn from experimental work of their own.

I should like to ask you to print these papers in full, that the eminent men who set them might have a chance of saying something, but on the whole I think your space is too valuable. I will simply quote two questions from the mechanics paper.

"(3) Explain how work is measured, and in what units.

"A 50 lb. shot is fired from a cannon with a velocity of 1500 feet per second. Compare the work done on the shot with that done by a man weighing 12 stone who walks up a hill 1500 feet high.

"(4) What is the mechanical advantage of a machine?

"How would you arrange three separate pulleys, each of which weighs 1 lb., so that the power required to raise a weight of 40 lbs. may be a minimum?

"What arrangement of pulleys is most commonly used in practice? And why?"

Now these are exactly the old Cambridge—"Describe the common pump, &c., questions?" and the way to answer them is to waste no time on experiments, but read your text-book, get up your formulæ and work examples. The second question is of exactly the same type. The other two require a graphical construction, but such as would be readily done by a boy who had used a text-book in which graphic methods were explained.

The first paper is almost equally bad; it is all (chemistry included) text-book science of a very common order. Against the practical paper I have nothing to say.

Now Cambridge men can write excellent elementary text-books on these subjects, witness those of Prof. Glazebrook. Can they not produce among them a paper on Elementary Experimental Science, which shall be what it professes to be, or is the tradition of the common pump still too strong, and the impress of the Mathematical Tripos too indelible?

A. H. F.

Literature of Coffee and Tobacco Planting.

IN the issue of NATURE of August 9 it is stated, in reviewing a book by a French author, that several books on the same subject, *i.e.* coffee—its growth, cultivation and preparation for the market—have already been published in English.

Could you kindly inform me of the names of the publishers or authors of any good works in English on coffee and tobacco growing? I have been, so far, quite unable, out here, to find the names of any publishers of works on tobacco or coffee, and as it is a matter of considerable moment to me to gain the best of information on these subjects, I trust you will see your way to help me.

Salisbury, Rhodesia, South Africa. G. H. JAMES.

[Mr. J. R. Jackson, Keeper of Museums at the Royal Gardens, Kew, to whom we referred our correspondent's inquiry, has kindly sent the following list of books, which may meet the requirements and also be of service to other planters.—ED. NATURE.]

WORKS ON COFFEE AND TOBACCO PLANTING.

"The Coffee Planter of Ceylon," by William Sabonadière. Published by E. and F. N. Spon, 125, Strand. (1870.)

"Coffee Planting in Southern India and Ceylon," by E. C. P. Hull. E. and F. N. Spon. (1877.)

Article on coffee in "Spon's Encyclopædia of the Industrial Arts, Manufactures and Commercial Products." E. and F. N. Spon.

"Liberian Coffee in Ceylon." From the *Ceylon Observer*. Published at Colombo by A. M. and F. Ferguson. (1878.)

"All About Tobacco." Compiled by A. M. and F. Ferguson, Colombo, Ceylon. Agents, John Haddon and Co., Bouverie Street, London.

Article on tobacco in "Spon's Encyclopædia of the Industrial Arts, Manufactures and Commercial Products." E. and F. N. Spon.

Autotomic Curves.

IN NATURE, October 11, Mr. A. B. Basset justly inveighs against the use of the term "non-singular curve" to denote a curve which has no double points. Doubtless, also, the expression "an anautotomic curve" is objectionable.

May I suggest that, in this instance, we may obtain from Latin the help unknown to Greek, and designate curves which have, and curves which have not, double points, by the terms *sesecting* and *non-sesecting* respectively?

H. LANGHORNE ORCHARD.

44 Denning Road, Hampstead, N.W., October 20.

IN answer to your correspondent, Mr. A. B. Basset, would not the Anglo-Saxon negative prefix "un" combine more euphoniously with "autotomic" than the Greek "an"? We find analogy for such a combination in the familiar words "unauthorised" and "unauthenticated," where it is used in conjunction with words of Latin origin; so there seems no valid philological objection to its association with a Greek derivative, while the phrase "an unautotomic curve" would certainly sound more pleasantly to the ear than "an anautotomic" one.

ARTHUR S. THORN.

4, Malcolm Road, Penge, S.E., October 25.

THE PRESENT CONDITION OF THE INDIGO INDUSTRY.

OF late years attention has often been drawn to German Technical Chemistry, more especially in connection with the advance and growth of the coal-tar colour industry, an industry which received its birth in this country, but which has now taken up its abode on the continent, the loss of the industry to this country being largely due to the conservatism of our manufacturers, and also partly to the want of proper scientific training on the part of the few chemists whom the manufacturers have *deigned* to employ.[1]

Before 1870 the madder plant was very largely cultivated, in order to obtain from it the important dye-stuff alizarin. But in 1869 a process for obtaining alizarin, by fusing anthraquinone sulphonic acid with caustic soda, was patented simultaneously in this country and in Germany. As a consequence the madder plant is now hardly cultivated at all.[2] Now, thirty years later, another and perhaps even more important natural dye-stuff is in jeopardy owing to the advances of German science. The dye-stuff referred to is indigo, which is cultivated in such large quantities in our Indian Empire. If, then, the natural indigo is to be driven out of the market by the artificial substance, prepared from coal-tar products, it cannot fail to exert a great temporary, if not permanent, influence upon the wealth of India. Perhaps, then, a

[1] In the hand-book for the International Exhibition of 1862 (vol. i. p. 120), the following sentences occur: "It is impossible to overrate the importance of the coal-tar dyes to this country. From having the sources of the raw material in unlimited quantities under our very feet, we are enabled to compete most favourably with continental nations in this respect, and we shall soon become the great colour-exporting country, instead of having, as hitherto, to depend on Holland and other countries for our supply of dye-stuffs."

[2] Madder root contains about 1 per cent. of alizarin, and in 1859–1868 the best qualities of Turkey roots fetched 50s. per cwt.; this would make the price of alizarin about 45s. per lb. When artificial alizarin was first produced, the dry product fetched about 45s. to 50s. per lb. A 20 per cent. paste of alizarin is now sold for 7d. per lb.

brief survey of the processes employed for producing the natural and artificial indigo may be of interest.

Indigo is one of the oldest dye-stuffs known, having been used in India and Egypt before the Christian era. Egyptian mummies are sometimes found with wrappings which have been dyed with indigo. The ancient Romans and Greeks were also familiar with this dye-stuff. Pliny the Younger mentions indigo in his writings, and in this connection it is interesting to note that adulteration of commercial articles was even practised in his days, for he states that indigo was at times adulterated with the excrement of pigeons and with chalk coloured with woad, but he says the pure article may be known by its burning with a purple flame when heated. Indigo was not introduced into Europe until the sixteenth century, and even then, owing to the strong opposition of the woad cultivators,[1] it was a long time before it came into general use. Indeed, so strong was the opposition and so great was the influence of the woad cultivators, that the employment of indigo was prohibited in England, France and Germany, its use in France being in the time of Henry IV. punished by death, it being called "Devil's Food." However, notwithstanding this powerful opposition, the employment of indigo as a dye gradually gained ground until to-day woad is scarcely cultivated and is no longer employed as a colouring matter, but is used in a certain process of indigo dyeing to cause fermentation and reduce the insoluble indigo blue into soluble indigo white.

The indigo plant (*Indigofera tinctoria*) belongs to the natural order Leguminosæ. It is obtained chiefly from India, especially from the provinces of Bengal, Madras and Oude. But it is also grown in some parts of Africa, in Java, China, Japan, Central America and Brazil. The land is ploughed in October or November, and the seed sown at the end of March or the beginning of April. The growth is very rapid, and the plant attains a height of about three feet. It is cut for the first time between the middle of June and the beginning of July. Two months later a second crop is taken, but the yield is smaller than that of the first crop. The land on which the indigo is cultivated is frequently very poor, and contains very little nitrogen, yet indigo is grown on the same land from year to year with only very occasional change of cropping, and this in spite of the fact that practically the only manure employed is *seet*, *i.e.* the indigo refuse, leaves, stalks, &c., which have been taken from the steeping vats. Notwithstanding, the crops obtained from year to year do not show much deterioration either in yield or quality. Dr. D. A. Voelcker, in his report on Indian agriculture, suggests that since indigo belongs to the order Leguminosæ, and it has been shown that certain legumes are able to absorb atmospheric nitrogen through the medium of *nodules* which form on the rootlets, that perhaps the indigo plant obtains the nitrogen it requires in this manner. The writer of this article is, however, not aware whether the subject has been investigated.

The dye indigo does not occur ready formed in the plant, but exists in the form of a glucoside called indican. This glucoside was isolated by Schunk. It is a brown, transparent, uncrystallisable syrup, which, by the action of dilute acids, is split up into indigotin (the colouring matter of indigo) and a sugar called indiglucin. A reaction similar to this is supposed to take place during the fermentation process in the production of natural indigo.

Manufacture.

The cut plant is tied into bundles, which are then packed into the fermenting vats and covered with clear fresh water. The vats, which are usually made of brick lined with cement, have an area of about 400 square feet and are 3 feet deep, are arranged in two rows, the tops of the bottom or "beating vats" being generally on a level with the bottoms of the fermenting vats. The indigo plant is allowed to steep till the rapid fermentation, which quickly sets in, has almost ceased, the time required being from 10–15 hours. The liquor, which varies from a pale straw colour to a golden-yellow, is then run into the beaters, where it is agitated either by men entering the vats and beating with oars, or by machinery. The colour of the liquid becomes green, then blue, and, finally, the indigo separates out as flakes, and is precipitated to the bottom of the vats. The indigo is allowed to thoroughly settle, when the supernatant liquid is drawn off. The pulpy mass of indigo is then boiled with water for some hours to remove impurities, filtered through thick woollen or coarse canvas bags, then pressed to remove as much of the moisture as possible, after which it is cut into cubes and finally air-dried.

Another method is to treat the plant with dilute ammonia or alkalis. This method is said to more completely decompose the indican, and thus to give a larger yield of indigo.

The value of indigo as a dye-stuff depends upon the quantity of indigotin which it contains. The percentage of indigotin in the natural indigo varies from 20–90 per cent. Beside indigotin, natural indigo also contains small and varying quantities of indigo red, indigo brown and indigo gluten. The following is an analysis of a good sample of Bengal indigo :—

Indigo blue	61·4 per cent.
Indigo red	7·2 ,,
Indigo brown	4·6 ,,
Indigo gluten	1·5 ,,
Mineral matter	19·6 ,,
Water	5·7 ,,

Artificial Indigo.

After many years of careful and laborious *scientific* work, artificial indigo is beginning to compete with natural indigo, and there seems to be but little doubt that, unless the producers of the natural article are able to improve the process of manufacture, in the near future the artificial product will, in all probability, get the upper hand in the struggle. Engler and Emmerling appear to have been the first chemists to obtain artificial indigo. They obtained it by the action of zinc dust and soda lime upon ortho-nitroacetophenon, but the quantity obtained was very minute, and, as the mechanism of the reaction was not at that time understood, it did not much help in paving the way for further research work. For most of our present knowledge of indigo we have to thank von Baeyer, whose work on indigo may be looked upon as one of the chemical triumphs of the century. So far back as 1868, von Baeyer obtained indol directly from indigo, and, in the following year, in conjunction with Emmerling, he prepared this substance by fusing crude nitrocinnamic acid with caustic potash and iron filings ; shortly afterwards they discovered that by the action of phosphorus trichloride, phosphorus and acetylchloride on isatin, a product was obtained, which, when exposed in aqueous solution to the action of the air, gradually deposited indigo ; this method was subsequently improved. In 1875 Nencki obtained indigo by the oxidation of indol with ozone. But it was not till the year 1880 that any great progress was made in the synthesis of indigo. In this year von Baeyer published a series of brilliant researches showing how indigo could be obtained from ortho-nitrocinnamic acid. He showed that when ortho-nitrocinnamic acid is subjected to the action of bromine, ortho-nitrodibromcinnamic acid is obtained, which when treated with alkalis in the cold is converted into ortho-nitrophenylpropiolic acid, and this substance, on being warmed with a dilute solution of caustic soda and grape sugar, or some other alkaline reducing agent, is converted into indigo, the yield compared with

[1] The colouring matter of woad, *Isatis tinctoria*, is indigo.

that theoretically possible being 70 per cent. Von Baeyer also showed that, by acting upon ortho-nitro-cinnamic acid with caustic soda and chlorine, ortho-nitro-phenylchlorolactic acid was produced, which on treatment with alcoholic caustic potash was converted into ortho-nitrophenyloxyacrylic acid, and this on being fused yields small quantities of indigo. Owing, however, to the high cost of ortho-nitrocinnamic acid, indigo so produced could not enter into competition with the natural dye. In 1882 von Baeyer and Drewson brought out yet another synthesis. They found that, by acting upon a mixture of ortho-nitrobenzaldehyde and acetone with caustic soda, indigo was produced, and, further, if the starting products were pure, that the yield of indigo was 80 per cent. of that theoretically obtainable. In 1890 Heumann discovered that when phenyl glycine was melted with caustic soda, taking care that air was, so far as possible, excluded, a yellow-coloured fuse was obtained. This fuse, on being dissolved in water and exposed to the action of the air, produced indigo.

Unfortunately, although the low price of the materials employed should have caused this to be a successful manufacturing process, the yield of the dye-stuff was very poor. Heumann shortly afterwards showed that a very much better yield could be obtained by employing phenylglycine-ortho-carboxylic acid, but although the yield was better the cost of production was higher, the more expensive anthranilic acid taking the place of the cheaper aniline as a starting product. Of late, however, the price of anthranilic acid, owing to improved methods of manufacture, has fallen very considerably, and, doubtless, will continue to fall. Indigo can also be obtained by fusing bromacetanilid with caustic potash, the indol so produced being oxidised by the action of the air to indigo. Again, when ortho-nitroacetophenone is carefully heated with zinc dust, a sublimate of indigo blue is obtained. There are many other syntheses of indigo known, but the majority of them are of more theoretical than practical importance.

Of the many methods for obtaining artificial indigo, only two or three modifications are employed for manufacturing the dye. These are von Baeyer's ortho-nitro-benzaldehyde and aceton synthesis, and that of Heumann from o-phenylglycinecarboxylic acid. But beside indigo itself there is a substance sold under the name of "indigo salt," which is the sodium bisulphite salt of the methylketone of o-nitrophenyl-lactic acid. It is readily soluble and is used for indigo printing.

Artificial indigo as brought into the market contains over 90 per cent. of indigotin, whereas in the natural product the quantity varies from 20 to 90 per cent. The artificial product, however, contains no indigo-red, indigo-brown, or indigo-gluten; whereas these substances are present in natural indigo, and exert an influence in dyeing certain shades of indigo. Indigo itself cannot be employed for dyeing owing to its insolubility. But when subjected to the action of reducing agents it is converted into *indigo-white*, which is soluble in alkalis. Wool or cotton dipped into such a vat and then exposed to the action of the air become dyed a fast blue.

One would have supposed that the indigo producers would have taken warning from the extinction of the artificial alizarin industry, and called to their aid experienced agriculturists to see if it were not possible to increase the yield and quality of the indigo plant, and chemical experts to endeavour to improve the process of manufacture. This, however, has not been done. The planter appears uncertain whether thick or thin seeding is the better, whether any other manure except *seet* should be employed. Again, whether the *seet* should be applied to the land fresh or whether it should first be allowed to ferment. The manufacturing is entirely conducted by "rule of thumb." It is a matter of dispute as to whether the bundles of indigo plant should be packed tightly or loosely in the vats. If the water employed should be hard or soft is purely a matter of individual opinion. Again, it is a question of debate as to how long the cut plant should be steeped, &c. The Badische Anilin Soda Fabrik is said to have invested 500,000*l*. in plant for the manufacture of artificial indigo. Will British (Indian) manufacturers never lay out capital in scientific investigation? Will they *never* realise that money so laid out is almost certain in the near future to bring in a rich return? In conclusion, I give the following quotation from the report on the trade of Frankfurt for 1899, by Consul-General Sir Charles Oppenheimer:—

"In the territories in which natural indigo is grown, the intensity and magnitude of the danger which lies in the advance of the artificial product ought not for a moment to be disregarded. The struggle between artificial and natural indigo has already commenced. The latter still shows some advantages, inasmuch as its bye-products, such as indigo gluten, indigo red, &c., aid the dyeing process to some extent. If natural indigo is to retain its position, every effort must be directed in a rational manner to organising its culture towards the manner in which it is collected, and the way the dye is shipped. In order to obtain a favourable result, the ablest experts should co-operate in this important task. To-day the fate of East Indian indigo culture lies unfortunately in the retorts of the chemical factories."

F. MOLLWO PERKIN.

THE FORM AND SIZE OF BACTERIA.

BACTERIA is a generic term that has been applied to an extensive group of single-celled organisms belonging to the lowest forms of plant life The bacteria obtain their nutriment from organic matter, either dead or living, and are therefore capable of leading a saprophytic or a parasitic existence. They are amongst the smallest forms of life with which the biologist has to deal, the transverse diameter of the individual cells seldom exceeding a few micro-millimetres, or it may be a fraction of a micro-millimetre. The highest powers of the microscope are consequently necessary for the study of their structure, which is of a simple character, consisting essentially of protoplasm with a containing cell-membrane. The most striking differences are to be found rather in the biological properties of the bacteria as promoters of decomposition, putrefaction and fermentation, or as the originators of morbid processes in plants and animals, than in any distinctive features they possess as vegetable cells. The following account is simply intended to give the reader who is not a specialist a general conception of the main types of these organisms, which form the special study of bacteriology.

It may, in the first instance, be pointed out that though the bacteria are microscopically minute organisms, yet considerable variations in shape and size occur. The illustrations in the accompanying plate have been selected to illustrate these two points. It will be seen that, for example, amongst the most widely known pathogenic organisms the variation in form is considerable, whilst in point of size the largest of these is many times greater than the smallest. Bacteriology is at present largely dependent for a classification of the bacteria upon the variations that occur in their shape. The individual cells multiply by a process of fission, and the fundamental forms are spherical, oval, rodlike or spiral in shape. At the same time the species cannot be entirely determined by the microscopic appearance. In fact, there are many organisms which it is impossible to identify until other characteristics, such as the macroscopic appearance of their artificial growth on suitable media, or their pathogenic effects on animals, have been observed. The fact has also to be remembered that a

particular organism may under different conditions assume changes in shape, and that even under apparently the same conditions variations in shape and size may occur.

The organisms of a spherical shape are termed Cocci, the individual cells appearing as spheres, except during the period of fission, when elongated or lance-shaped forms occur—e.g. *Diplococcus pneumoniae*. The mode of cell-division determines the nomenclature applied to the various classes of cocci—those dividing in one direction and remaining attached in pairs or chains are termed diplo- or strepto-cocci; those dividing in two directions and forming groups of four—tetracocci; those dividing in three directions and forming packets—sarcinæ; and those dividing irregularly into grape-like clusters—staphylococci.

The standard of measurement for bacteria is the *mikron*, equal to 1/1000 part of a millimetre, and represented by the sign μ. The diameter of the cocci varies from about 0·3 to 3μ.

The organisms in which the length is always greater than the breadth are termed bacilli. Their shape is cylindrical, and they assume a rod-like form; of the most important forms the length may vary from $0·5\mu$ to $3·5\mu$, and the breadth from 0·5 to $0·8\mu$. The bacilli may occur isolated, in pairs, or in chains.

The third main group, the spirilla, are spiral in shape, or more accurately their form represents the fraction of the thread of a screw. The spirilla, like the bacilli, divide in one direction, and may occur as comma, S-shaped or corkscrew forms. The cholera organism has a diameter of about $0·4\mu$.

The transverse diameter is usually taken as the standard of measurement, as it is more constant than the long diameter of the bacteria.

The dimensions of the organisms shown in the accompanying illustrations are as follows:—*Streptococcus pyogenes*, $0·6–0·8\mu$; *Staphylococcus pyogenes aureus*, $0·7–1\mu$; *Diplococcus pneumoniae*, $0·5–0·8\mu$; *Bacillus pestis*, B. $0·6\mu$, L. $0·6–1·9\mu$; *Spirillum cholerae*, B. $0·4–0·6\mu$, L. $0·8–2\mu$; *Bacillus typhosus*, B. $0·6–0·8\mu$, L. $1–3·2\mu$; *Bacillus tetani*, B. $0·5\mu$, L. $1·2–3·6\mu$.

The example seen in Fig. 1 is the *Streptococcus pyogenes*, which is responsible for various septic processes in man. The grouping into chains is a characteristic feature of this organism. There is little variation in size of the individual members of the chain, with the exception of detached or isolated cells, which may be double the size of the normal cocci, *e.g.* when cell-division occurs. Micrococci are not generally subject to such individual variations as bacilli, as can be seen in Fig. 2, *Staphylococcus pyogenes aureus*, where only slight variations in size are to be detected. In Fig. 3 is an example of a very pleomorphic organism, the plague bacillus. It is ordinarily a very short, thick rod, almost appearing as a diplococcus when subdivision occurs. In the photograph, one rod is seen which is about six times the size of the others, and this is by no means uncommon. In a fluid culture the form of the plague bacillus is entirely altered, the organism almost assuming the appearance of Fig. 1. The *Micrococcus pneumoniae* (Fig. 4) is one of the most variable of the diplococci, the individuals in a pair being rarely equal in size, and sometimes elongated, as seen in the photograph. The cholera organism (Fig. 5) is inconstant in size, and its chief characteristic is the bent rod or comma shape. The tetanus bacillus (Fig. 6) is of large size in relation to the other organisms noticed. It is usually a straight rod, except when spore-formation occurs, when it assumes the drum-stick appearance, as seen in the photograph. The typhoid bacillus (Figs. 7 and 8) is very variable in size, although its rod-like shape is constant. The organisms generally have been stained with gentian violet, except in Fig. 8, where Van Ermengem's method for demonstrating flagella has been adopted. This process is not a true staining method, it is really a deposit of a silver-salt on the organism and its flagella. The organism appears much larger than when stained in the ordinary way. Many organisms are like the typhoid bacillus, endowed with flagella, which are probably exclusively organs of locomotion. In Fig. 8 they surround the bacillus, and are many times longer than the organism itself. In other organisms one finds sometimes unipolar or bi-polar flagella.

The illustrations accompanying this article have been produced in the photographic laboratory of the Jenner Institute of Preventive Medicine. The magnification is in all cases 1750 diameters, this being regarded as the highest at which satisfactory photographs of bacteria can be taken, a higher magnification generally resulting in the outline of the organism becoming blurred. The objectives used were a Zeiss 3 mm. apochromatic and a Winkel 1·8 mm. fluorite system, low-power projection oculars being used in each case, and magnification obtained by suitable camera extension. The organisms were all stained, so that a yellow screen was necessary when photographing. The screen used was a saturated solution of acridine yellow, about 15 mm. thick, and with this uniformly satisfactory results have been obtained.

ALLAN MACFADYEN.
J. E. BARNARD.

NOTES.

THE 101st anniversary of the death of Domenico Cirillo, friend of Linnæus, and famous both as botanist and physician, occurred on Monday, October 29. The account of the life and work of this great Neapolitan, given by Prof. Giglioli in another part of the present issue, appears, therefore, at a very appropriate time, and will be read with much interest by every naturalist. We are glad to be able to publish this appreciative notice of some of Cirillo's contributions to science, and thus to add to the number of those who, knowing his works and career, will cherish his memory.

THE announcement of the death of Prof. Max Müller, at Oxford on Sunday last, has been received with universal regret. The funeral has been arranged to take place to-day at Holywell Cemetery, Oxford.

ACCORDING to a *Times* report from Constantinople, "An Imperial Iradé prohibits star-worship and Sabianism in Turkey." It would be interesting to know more exactly what has been prohibited.

THE new science laboratories at King's College were opened by Lord Lister on Tuesday afternoon.

THE death is announced of Mr. William Anderson, professor of anatomy to the Royal Academy of Arts, and the author of a number of works on surgery and anatomy.

A COURSE of Cantor lectures by Prof. J. A. Fleming, F.R.S., on "Electric Oscillations and Electric Waves," will be delivered on Monday evenings in November and December at the Society of Arts.

A DESTRUCTIVE series of earthquake shocks occurred at Caracas, the capital of Venezuela, and the surrounding districts on Tuesday, October 30. The town of Guaronas has been entirely destroyed.

A VISIT to the Chelsea Physic Garden is enough to convince any one of the urgent need of new greenhouses to replace the dilapidated structures in which the existing collections are housed. A more ruinous building than the central range it would be

difficult to imagine, and unless new accommodation be speedily provided for its inmates, the winter's mortality amongst them must be very great. We understand that plans for the erection of new planthouses have for some time been under consideration, and it is much to be hoped that they may be followed by tangible results with as little delay as possible. Under the new *régime*, the garden, with its increased resources, is proving of great use to institutions in which botany forms part of the curriculum, and it would be a great pity if, owing to avoidable damage, its growing utility should be impaired.

IT is stated in the *Bulletin* of the American Mathematical Society that the Steiner prizes of six thousand marks, which were not awarded, owing to no papers being presented, have been divided into three parts which have been given to Prof. Karl Friedrich Geiser, Zurich, for his researches in geometry and his services in the publication of Steiner's lectures; to Prof. David Hilbert, Göttingen, for his researches on the axioms of geometry and for the advancement which analytic geometry has experienced from his work on the theory of of invariants, and to Prof. Ferdinand Lindemann, Munich, who has earned special distinction in geometry by his celebrated discussion of the quadrature of the circle, as well as by editing Clebsch's "Vorlesungen über Geometrie."

THE Senate of New York University has (says *Science*) received and confirmed the votes of its judges selecting thirty eminent native-born Americans whose names are to be inscribed in the "Hall of Fame," now in course of construction on University Heights, New York City. The Americans selected as the most eminent are distributed as follows: Rulers and statesmen, 7; authors, 4; inventors, 4; preachers and theologians, 3; judges and lawyers, 3; soldiers and sailors, 3; men of science, 2; philanthropists, 2; educators, 1; painters, 1. The inventors on this list are Fulton, Morse, Whitney and Howe, and the men of science Audubon and Gray. Franklin is of course also included. Of the hundred judges appointed, ninety-seven voted and the votes cast for men of science were as follows: John James Audubon, 67; Asa Gray, 51; Joseph Henry, 44; Matthew Fontaine Maury, 20; Benjamin Thompson, 19; Benjamin Silliman, 16; Benjamin Peirce, 14; Nathaniel Bowditch, 10; Alexander B. Bache, 9; Spencer Baird, 8; Henry Draper, 8; Maria Mitchell, 7; David Rittenhouse, 6. Twenty further names are to be selected in 1902 by the same judges.

REFERENCE has already been made to the medal which the Queensland Branch of the Royal Geographical Society of Australasia has decided to award. From a circular that has reached us, we learn that the medal has been instituted in recognition of Mr. J. P. Thomson's services to the Society, and is to be called "The Thomson Foundation Medal." It will be awarded annually, or at such other times as the Council may approve, to the author of the best original contribution to geographical literature.

IN memory of the late Dr. R. T. Manson, F.G.S., a well-known naturalist and geologist, a large granite boulder has been taken from the bed of the River Tees and placed on a pedestal in the Public Park, Darlington. The stone weighs about twelve tons, and it is admitted to have come originally from Shap, in Westmorland, in the Great Ice Age. It had been deposited 300 yards above Winston Bridge on the shape and limestone bed of the Tees, where the formation is of the carboniferous age.

THE Board of Education have received, through the Foreign Office, copies of the official translation of the statutes and regulations of the Nobel Bequest. It will be remembered that Dr. Nobel left a large sum, the interest on which was to be devoted to prizes to those who in the course of the previous year should have rendered the greatest service to mankind. The amount thus available was to be divided into five equal parts, to be assigned as follows:—(1) To the most important discovery or invention in the domain of the physical sciences; (2) To the most important discovery or improvement in chemistry; (3) To the most important discovery in physiology or medicine; (4) To the most remarkable literary work (l'ouvrage littéraire le plus remarquable dans le sens de l'idéalisme); and (5) To the person who should have rendered the greatest service in the cause of international brotherhood, in the suppression or reduction of standing armies or in the establishment or furtherance of Peace Congresses. The competition was open to the whole world. It has been found necessary to embody the testator's wishes in a somewhat lengthy and complicated body of statutes. The Board of Education are causing copies of the official translation in French) of these statutes to be transmitted to a number of the chief libraries in England and Wales, to the Universities and University Colleges, to a number of learned societies and to the Press. The regulations for the competition (which will, if possible, be held for the first time in 1901) can thus be consulted by persons interested in the matter.

IT is proposed to publish in separate volumes the lectures on the principles of geology, delivered at the Johns Hopkins University, under the George Huntington Memorial Fund; and subscriptions for the volumes are invited by Prof. W. Bullock Clark, Baltimore,' Maryland, U.S.A. The lectures have been given by geologists of international reputation, a fund having been provided for that purpose by the generosity of Mrs. Williams, who thus commemorates the name and work of her husband, formerly professor of inorganic geology in the Johns Hopkins University. The lectureship was inaugurated in April, 1897, by Sir Archibald Geikie, who delivered six lectures on "The Founders of Geology," which have already been published by Messrs. Macmillan and Co. A second course was given in April, 1900, by Prof. W. C. Brögger, who delivered two lectures on the principles of a genetic classification of the igneous rocks, followed by five lectures on the late geological history of Scandinavia, as shown by changes of level and climate since the close of the glacial epoch. Other lectures will be delivered from time to time and will be published in a uniform style. The volumes will thus contain authoritative opinions regarding the fundamental facts of geological science.

THE first place in the *Quarterly Review* is given to a descriptive account of malaria and its relation to mosquitoes, in which some of the facts in seven recent volumes and reports dealing with the subject are considered. To any one who has not had before him the statistics as to the number of deaths from malaria, the mortality from the disease is astonishing. It has been said that one half the mortality of the human race is due to malaria, and though this may very well be an exaggeration, the figures given in the review show the deadly character of the disease and the vast extent of its field of activity. Apart from the mortality, it is stated that the disease probably levies a heavier tribute in the capacity of the officers and officials who administer the British Empire than does any other single agency. Laveran's discovery, in 1880, of the small organism responsible for the disease is, therefore, worthy of greater glory than the victories of any general or the triumph of any political party, for it has greater influence upon human affairs. Lankester had previously described a parasitic organism living in the blood-cells of a frog, and these purely scientific observations laid the foundation for the mosquito-malaric theory propounded by Dr. Manson, and established by the brilliant researches of Ross, Grassi, Bastianelli, Bignami and others. The whole story is told in the review, and it affords another instance of the far-reaching value of scientific work which at the commencement appears to have no practical applications.

In the Geological Series, Vol. i., No. 7, of the Field Columbian Museum publications, Dr. O. C. Farrington describes some new mineral occurrences in America. These include, amongst others, the rare inesite from a mine near Villa Corona, Mexico, a mineral which is only known from three other localities in the world; also some curious crystals of golden calcite from the Bad Lands region, which exhibit such distortion as to have an apparent prismatic form. There is an interesting note also on the use of dolomite as money by the Pomo Indians, inhabiting Lake County, California. The dolomite money is fashioned by cutting symmetrically-shaped cylindrical pieces from the rough pebbles. These are afterwards burned to bring out streaks of a reddish colour and are then polished and perforated. It is stated that a well-worked piece is estimated at almost the value of its weight in gold. A second section of this publication deals with some interesting crystal forms of calcite from Joplin, Missouri, which are remarkable "not only for their size, but for their transparency, varied colour and the perfection of their crystal form." The paper is well illustrated.

IN an article on "The Orange River Ground Moraine" (*Trans.* S. African Phil. Soc. vol. xi. part 2, September 1900), Messrs. A. W. Rogers and E. H. L. Schwarz describe the glacial characters of the Prieska conglomerate which occurs beneath the Kimberley shales. In their opinion it is a true till formed by land-ice; numerous striæ are to be found on the boulders, while the rock-surfaces underlying the conglomerate are clearly glaciated. A number of photographic plates support the conclusions of the authors. They remark that the relationship between the Prieska conglomerate and that known as the Dwyka conglomerate is still uncertain. The Dwyka conglomerate forms the base of the Mesozoic group, and has long been regarded as of glacial origin. An important paper on the chemical composition of the soils of the south-western districts of Cape Colony is contributed to the same publication by Mr. Charles F. Juritz.

PROF. W. M. DAVIS announces (*Appalachia*, vol. ix., March 1900) that his doubts as to the ability of ice to erode deep valleys and basins have been dispelled by a study of the valley of the Ticino, towards St. Gotthard. The fact that the side valleys open into the main valley several hundred feet up, indicates that the ice-stream, while deepening the main channel, rose high enough to prevent the small lateral glaciers from exercising much erosive power on their courses. In a second article (*Proc.* Boston Soc. Nat. Hist., vol. xxix., July 1900) Prof. Davis pursues the subject of "Over-deepened main valleys and hanging lateral valleys," and deals also with the excavation of lake-basins by ice-action.

THE well-known formula for the velocity of propagation of capillary waves or "ripples" shows that the surface-tension of a liquid can be determined experimentally by observing the wave-length and velocity, or the wave-length and frequency of such waves. Dr. Leo Grunmach, of Berlin, has successfully applied this method to liquids, and he now communicates to the *Sitzungsberichte* of the Berlin Academy an account of determinations of the capillary constants of liquefied gases by the same method. The waves are excited by a tuning-fork with needle points dipping into the liquid, and the interference-curves enable the wave-lengths to be measured with considerable accuracy. The method has been applied to liquefied sulphurous acid, Pictet's fluid (a mixture of 64 parts by weight of sulphurous acid with 44 parts carbonic acid), liquefied ammonia and liquefied chlorine, and the values of the capillary constants will, it is surmised, lead to interesting results in connection with critical point investigations.

THE smallest lateral difference of place that is just visible has, until recently, been given as about 50″ to 1′ angular measure. The method employed by Helmholtz and others in reaching this result was the well-known one of bringing two parallel lines together until they finally are just distinguished as two. Prof. George M. Stratton, writing in the *Psychological Review* for September, describes a different method by which it is now evident that a lateral difference of place of about 7″ of arc can be directly perceived. Instead of using lines or points side by side, the experiments which gave this result were made with lines end to end, so arranged that the upper of two perpendiculars could be moved at will to the right or left, while still remaining exactly parallel to the lower line. The observer had simply to judge whether the upper line was continuous with the lower or to which side it was displaced. The results, which gave 7″ as the threshold of space distinction under these conditions, are interesting, as explaining Bourdon's experiments, according to which a difference of position amounting to but 5″ gives a perceptible stereoscopic effect.

MR. FRANK B. WILLIAMS contributes to the *Proceedings* of the American Academy of Arts and Sciences a paper on the geometry on ruled quartic surfaces. Of the quartic scrolls Cremona enumerates twelve, while Cayley divides these scrolls into ten species, stating that Cremona's two remaining species, though properly considered as distinct from the others, may be regarded as sub-forms of his seventh and ninth species. These two are the developable quartic or torse, whose edge of regression is a twisted cubic, and the quartic cones. It is the purpose of Mr. Williams's paper to consider the classification of curves on all ruled quartic surfaces, to find the formula for the number of intersections of any two curves that lie on the same ruled quartic surface, and to point out some of the most notable results obtained in the course of the investigation. The equations of many of the ruled quartic surfaces are so complicated that very serious difficulties arise when we attempt to treat them analytically, and the author finds it convenient to employ the synthetic method of Prof. Story.

MR. F. J. ROGERS, in the August number of the *Physical Review*, advocates the use of the M.K.S., or metre-kilogram-second, system of units in solving problems in mechanics where solutions involving the C.G.S. units of force and work lead to enormously large numerical measures. The author remarks that the common mode of abbreviating these large numbers by using powers of ten gives some trouble to beginners. Mr. Rogers suggests that the corresponding absolute unit of force may be called the large dyne, or the *Dyne* spelt with a big D; but this nomenclature seems capable of improvement in order to avoid confusion with the megadyne, which contains ten of his large dynes.

A SERIES of interesting experiments on the explosive effects of the modern infantry bullet have been carried out in Germany by C. Cranz and K. R. Koch. They used a new Mauser rifle of 6 mm. bore, having a muzzle velocity 100 m. greater than "Model 88." To imitate the effect upon large blood-vessels, while at the same time obtaining simple physical conditions, the experimenters constructed short hollow tin cylinders filled with water, and closed at one end with a sheet of rubber, and at the other with a sheet of parchment paper. Electrodes were mounted before or behind the cylinders, or inside them, and the discharge spark produced by the bullet was utilised to obtain a photograph of its silhouette at various points of its path. Among the important facts thus elicited it appears that the body struck is not displaced by the entry of the bullet. On leaving the body, the bullet carries away with it a small part of the hind surface, having a small round perforation through which the bullet passed. The "explosion" does not take place until the bullet has left the body. After discussing the evaporation, hydraulic-pressure, rotation, and sound-wave theories of the explosion, and discarding them all, the authors conclude that

the apparent explosion is due to the transfer of kinetic energy to the portions hit at later stages, which are thus torn away from those first encountered.

WE have received from Dr. W. Doberck a copy of the observations made at the Hong Kong Observatory during the year 1899, containing hourly values and results of the principal meteorological elements. The volume is the sixteenth of this important series, and the observations are enhanced in value by the fact of their publication on a uniform plan, which admits of comparison of the means of one year with those of another. The weather forecasts show a high degree of success; following the method of analysis usually adopted, and adding together the sum of total and partial success, the percentage amounts to 94. The collection of observations made in the eastern seas and their collation in one-degree squares, for the construction of trustworthy pilot charts, are actively carried on, and these observations are supplemented by registers kept at forty stations on shore. Astronomical and magnetic observations are also regularly made, and the results published in the volume above referred to. The time-ball was successfully dropped throughout the year, with only seven cases of failure.

IT was only in 1889 that Dr. Merriam, in the "North American Fauna," published a synopsis of the pocket-gophers of the genus Perognathus; but since that date a host of new species and races have been described. Accordingly, a revision of the group has been found necessary, which has been carried out by Mr. W. H. Osgood in No. 18 of the publication cited, several new forms being added to the already large list.

WE have received parts iii. and vi. of "Papers from the Harriman Alaska Expedition" (*Proc. Washington Academy*, vol. ii.), the former, by Mr. W. E. Ritter and Miss G. R. Crocker, dealing with the multiplication of rays in a 20-rayed starfish and its bilateral symmetry, and the latter, by Miss A. Robertson, treating of the Bryozoa. The most interesting feature in connection with the starfish (*Pycnopodia helianthoides*) is the presumed relation between one of its arms and the so-called larval organ of the embryo. In regard to the Bryozoa, Miss Robertson remarks that many of the Alaskan species are common to Queen Charlotte Islands, Paget Sound and California. The distribution of all the forms found on the western coast of North America is given, several new species being described.

THE first half of Part iv. of vol. xxviii. of the *Morphologisches Jahrbuch* is taken up by the final instalment of Dr. S. Paulli's important memoir on the pneumatic cavities in the mammalian skull. It is concluded that the homology of these cavities can only be determined by means of their relations to the nasal chamber, and that the terms "frontal" and "sphenoidal sinus" have no morphological value. In Monotremes, pneumatic chambers are wanting, and in other groups the capacity of these increases with the bodily size of the species in which they occur. The second half of the same fasciculus contains the commencement of a memoir by Prof. L. Bolk on the anatomy of apes, the gravid uterus of the langur (Semnopithecus) being the first subject for consideration.

DR. A. B. MEYER, the Director of the Dresden Museum, has sent us the first instalment of a work entitled "Ueber Museen des Ostens der Vereinigten Staaten von Nord Amerika; Reisestudien." In the autumn of 1899, Dr. Meyer undertook a journey to the States for the purpose of inspecting the museums and their methods of arrangement and conservancy, and the present issue describes some of the results of his survey. As is well known, Dr. Meyer has paid particular attention to the constuction of museum cases and cabinets, and he seems to have been much interested in some of those in use in America. The present part, which is lavishly illustrated, deals with the museums of New York City, Albany and Buffalo. One of the most striking photographs represents the gallery of Mexican antiquities in the American Museum of Natural History, New York.

WE have received "Verhandlungen der Deutschen Zoologischen Gesellschaft auf der zehnten Jahresversammlung zu Graz, den 18, bis 20, April 1900," which contain a number of short papers on zoological subjects chiefly interesting to specialists. We have likewise been favoured with copies of the *Bulletin International de l'Académie des Sciences de Cracovie, Comptes rendus*, for May and July 1900. Among other papers, the latter contains a communication, by M. E. Godlewski, on the effects of oxygen on the development of the embryo of the frog; and a second, by M. S. Maziarski, on the structure of the salivary glands. The last-named author has succeeded in modelling these glands on an enlarged scale in wax, and his paper is illustrated by a plate showing some of these models.

THE following lectures will be given at the Royal Victoria Hall, Waterloo Road, during November:—November 6, "Plants of Long Ago," Mr. A. Seward, F.R.S.; November 13, "Flowers from an Insect's Point of View," Prof. J. B. Farmer; November 20, "The Medicinal Wells of Old London," Mr. W. H. Shrubsole; November 27, "Some Unknown Countries north of Tanganyika," Mr. J. E. S. Moore.

THE sixth volume of *The Reliquary and Illustrated Archæologist*, comprising the four quarterly numbers issued this year, has been published by Messrs. Bemrose and Sons. The separate numbers of the magazine have been noticed in these columns as they appeared, but this need not prevent us from remarking that Mr. Romilly Allen, who edits the publication, and his fellow archæologists, are to be congratulated upon the excellent character of the text and illustrations of their organ.

DR. M. C. COOKE's book entitled "One Thousand Objects for the Microscope" is well known to microscopists, and the new edition, which has just been published by Messrs. Frederick Warne and Co., is likely to have an even wider sphere of usefulness. Originally, the book consisted of a list of objects, with brief notes upon their microscopic characteristics. Preceding this, Dr. Cooke now gives a description of the microscope and its essential accessories, with hints on their manipulation, and on the collection and mounting of the different classes of objects enumerated. The book is thus now a complete guide for beginners of practical microscopy, and will be of assistance to all who have a microscope and wish to know how to make good use of it.

THE number of cases of the production of true nitro-derivatives in the fatty series by direct nitration with fuming nitric acid is practically limited to the work of Franchimont and Klobbie and Ruhemann and Orton on malonic acid derivatives. In the current number of the *Comptes rendus*, MM. Bouveault and Wahl give the results of some successful experiments upon the direct nitration of unsaturated fatty compounds. With the ethyl ester of dimethylacrylic acid, a good yield of a mono-nitro-derivative is formed, which possesses acid properties, forming a potassium salt; from which, on treating with acid, an ethyl nitrodimethylacrylate isomeric with the original compound is obtained.

NEARLY forty years ago Schönbein showed how, on shaking lead amalgam with air and water, equivalent quantities of lead oxide and hydrogen peroxide were formed. In recent years many isolated cases have been described of this so-called autoxidation or simultaneous oxidation of two substances by air, one being incapable of oxidation by air alone—the researches of Bamberger,

and of Manchot in particular, proving the production of hydrogen peroxide in such cases. Engler has recently suggested that probably in all such cases hydrogen peroxide is formed simultaneously, half the oxygen molecule going to oxidise the substance present, and the other atom forming hydrogen peroxide. In many cases the formation of the latter substance is difficult to prove on account of its secondary oxidising action upon the substance used. In the current number of the *Berichte*, Dr. H. Biltz describes experiments on the oxidation of the hydrazone of dibromoxybenzaldehyde in alkaline solution by air at the ordinary temperature, and in this case he has been able to prove that the amount of oxygen in the hydrogen peroxide formed is exactly equal to the oxygen used up by the hydrazone.

THE same number of the *Berichte* also contains an account by Prof. Curtius of what appears to be a new general method of preparing aromatic aldehydes from the corresponding acids. By the action of dilute alkalis upon benzhydrazide,

$$C_6H_5.CO.NH.NH_2,$$

benzalbenzoylhydrazine,

$$C_6H_5.CO.NH.N:CH.C_6H_5,$$

is obtained, and this gives benzaldehyde upon hydrolysis with dilute acids. Prof. Curtius makes no attempt to explain the mechanism of this reaction, but states that a similar reduction in alkaline solution has been found to take place with many acid hydrazides with formation of the corresponding tertiary hydrazones

$$R.CO.NH.N:CH.R,$$

the latter being insoluble substances capable of easy isolation in a pure state, and in good yields. Distillation with dilute sulphuric acid then gives the corresponding aldehyde.

THE additions to the Zoological Society's Gardens during the past week include two Common Marmosets (*Hapale jacchus*) from South-east Brazil, presented by Lady Mackenzie; a Persian Gazelle (*Gazella subgutterosa*) from Central Asia, presented by Mr. B. T. Ffinch; a Red-necked Bustard (*Eupodotis ruficollis*?) from South Africa, presented by Mr. J. E. Matcham; a Raven (*Corvus corax*), European, presented by Mr. F. Sykes; seven Gold Pheasants (*Thaumalea picta*) from China, presented by Mr. Henry G. Hobbs; a Carrion Crow (*Corvus corone*) captured at sea, presented by Mr. S. T. Henderson; a Bearded Tit (*Panurus biarmicus*), European, presented by Mr. A. R. Gillman; a Spotted Slow Skink (*Acontias meleagris*) from South Africa, presented by Mr. W. L. Sclater; a Green Lizard (*Lacerta viridis*), European, presented by Dr. Dyer; two Severe Macaws (*Ara severa*) from South America, two Spotted Eagle Owls (*Bubo maculosa*) from Africa, a Westerman's Eclectus (*Eclectus westermani*) from Moluccas, six —— Finches (*Munia*, sp. inc.) from India, two Simony's Lizards (*Lacerta simonyi*) from the Canaries, a Mocassin Snake (*Tropidonotus fasciatus*), a Caroline Anolis (*Anolis carolinensis*) from North America, two Leopardine Snakes (*Coluber leopardinus*), two Vivacious Snakes (*Tarbophis fallax*), an Œsculapian Snake (*Coluber longissimus*), a Four-lined Snake (*Coluber quatuorlineatus*), a Lacertine Snake (*Coelopeltis monspessulana*), South European, deposited; two Hog Deer (*Cervus porcinus*), two Dwarf Turtle Doves (*Turtur humilis*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN NOVEMBER.

Nov. 1. 9h. 11m. Minimum of Algol (β-Persei).
4. 6h. 0h. ,, ,, ,,
6. 9h. 54m. to 10h. 58m. π Arietis (mag. 5·6) occulted by the moon.
6. 13h. 47m. to 14h. 31m. ρ³ Arietis (mag. 5·5) occulted by the moon.
11. 14h. 38m. to 15h. 56m. ι Cancri (mag. 5·9) occulted by the moon.
12. 11h. 54m. to 12h. 58m. A¹ Cancri (mag. 5·6) occulted by the moon.
12. 14h. 45m. to 14h. 56m. A² Cancri (mag. 5·8) occulted by the moon.
14. 5h. Mars in conjunction with moon. Mars 7° 39′ N.
14–15. Epoch of the November meteors. Leonids. (Radiant 150 + 23.)
15. Venus. Illuminated portion of disc = 0·751.
Mars. ,, ,, ,, = 0·896.
15. Saturn. Outer minor axis of outer ring = 15″·99.
18. 13h. Venus in conjunction with moon. Venus 5° 51′ N.
21. 10h. 53m. Minimum of Algol (β Persei).
21. 19h. 23m. Eclipse of the sun invisible at Greenwich.
23. 5h. Jupiter in conjunction with moon. Jupiter 1° 3′ S.
23–24. Epoch of the meteoric shower of Biela's comet. (Radiant 25 + 43.)
24. 7h. 42m. Minimum of Algol (β Persei).
24. 12h. Saturn in conjunction with moon. Saturn 2° 8′ S.
27. 4h. 31m. Minimum of Algol (β Persei).
30. 6h. 11m. to 7h. 7m. κ Piscium (mag. 5·0) occulted by moon.

EPHEMERIS OF EROS FOR NOVEMBER.

Ephemeris for 12h. Berlin Mean Time.

1900.		R.A. h. m. s.		Decl. ° ′ ″
Nov. 1	...	2 15 8·32	...	+53 51 11·3
3	...	11 12·42	...	54 4 35·2
5	...	7 9·87	...	54 14 11·0
7	...	2 3 3·43	...	54 19 50·8
9	...	1 58 56·02	...	54 21 27·8
11	...	54 50·81	...	54 18 57·3
13	...	50 51·14	...	54 12 17·6
15	...	47 0·38	...	54 1 29·6
17	...	43 21·88	...	53 46 37·7
19	...	39 58·79	...	53 27 48·8
21	...	36 53·99	...	53 5 13·1
23	...	34 10·09	...	52 39 3·2
25	...	31 49·22	...	52 9 33·6
27	...	29 53·06	...	51 37 0·3
29	...	1 28 22·83	...	+51 1 40·1

FIREBALLS.—On Sunday evening, October 21, there appear to have been a remarkable prevalence of brilliant meteors. They were noticed at about 8h. 35m., 8h. 40m., 9h. 30m., 10h. and 11h. 58m. The first of these was a magnificent object, and it lit up the sky with three flashes which many people mistook for ordinary lightning. The night was very cold and clear throughout the country, and a great number of descriptions of the fireball alluded to have been published in the newspapers. Its flight was exceedingly slow from S.W. to N.E., and it appears to have been directed from a radiant point either in Capricornus or Aquila. The accounts are, however, somewhat conflicting. Near its disappearance the meteor had a height of between 20 and 30 miles over the Midlands, and a detonation was noticed at several places, including Tewkesbury and Clun, Shropshire.

On October 27, 11h. 42m., a magnificent meteor was seen by Mr. Denning at Bristol, traversing a path from 79° + 33° to 56° + 24¾°, and directed from a radiant at 136° + 34°. The object left a brilliant, irregular streak, one section of which remained visible in an opera glass for 13 minutes, during which time it drifted 17° in a southerly direction.

TEMPERATURE OBSERVATIONS DURING SOLAR ECLIPSE.—Mr. C. Martin made a systematic series of temperature observations during the eclipse of the sun on May 28, 1900, and his results are published in the *Scientific Proceedings of the Royal Dublin Society*, vol. ix. pt. 3, pp. 362–364. The observations were made with two instruments, one having a black bulb, the other with a white one. These were mounted about an inch apart on a black wooden post, some six feet high, the bulbs being six inches from any part of the woodwork, and pointed directly towards the sun. Parts of the first stages of the eclipse were rendered inactive by clouds, but for a period of two hours good readings were obtained. These are plotted as curves, the results from the two instruments being given both individually and in combination, the agreement being very close; if anything, the white bulb thermometer moved less quickly than the black,

and is thus the less sensitive of the two instruments. An examination in detail of these curves shows that the temperature was at its lowest about eight minutes after the middle of the eclipse, and began to rise rapidly as the eclipsed portions of the sun became less. The highest reading with the black bulb thermometer before the eclipse began was 63°·7, the lowest during eclipse being 35°·7, showing a fall of 28°. With the white bulb the corresponding readings were 15°·6 and 3° respectively, showing a drop of 12°·6.

DOMENICO CIRILLO AND THE CHEMICAL ACTION OF LIGHT IN CONNECTION WITH VEGETABLE IRRITABILITY.

ONE hundred and one years ago, on October 29, 1799, Domenico Cirillo, the Neapolitan Linnæus, was hanged on the market-place of Naples, together with some of the noblest among Italian men of letters and science. It is especially fitting to remember Cirillo in England, the country which he visited and where he had many friends, and for the literature and science of which he showed a special predilection—a country which unfortunately had such a fatal influence upon his destiny.

The Cirillos of Grumo, a village of Terra di Lavoro, were a family of doctors, naturalists and artists. At the beginning of the eighteenth century Nicola Cirillo was famed, both as a physician and a botanist. Following the best traditions of Neapolitan science, the traditions of Pinelli, of Imperato, and of Maranta, Nicola Cirillo instituted a private botanical garden, the only one then existing in Naples. In 1718 he became a Fellow of the Royal Society of London, and in connection with this Society, then presided over by Sir Isaac Newton, Nicola Cirillo began to collect meteorological data on the climate of Naples. After his death, in 1734, his botanical garden and his collections, together with the famous herbarium of Ferrante Imperato, were preserved, and the garden improved with the more recent systems of classification by Sante Cirillo, painter and naturalist, whose house became a centre of the learning and culture of Naples.[1]

Domenico Cirillo was born in 1739, and so profited by the education and influence of Sante, his uncle, of Nicola Capasso, Francesco Serao, and of other teachers, that at the age of twenty-one, in 1760, he successfully competed for the chair of botany in the University of Naples. Domenico Cirillo, indeed, followed in the track of Nicola, and soon became known both as a botanist and as a physician. In numerous botanical excursions he visited the greater part of the provinces of Southern Italy and Sicily; and he was the first to organise in this country a regular botanical survey, sending out pupils and assistants to collect in different provinces. Thus not only many rare plants were described in his "Fascicoli Plantarum rariorum Regni Napolitani," begun in 1788, but several new species were discovered. At present, in the Italian flora, about thirteen species of phanerogams are retained as first discovered and described by Cirillo.

That period, when men worked under the spell of Linnæus, was a time of great botanical fervour, of *furore botanico* to use Cirillo's expression, in the collecting and investigating of plants. Of Cirillo's early connection with Linnæus, botanists are still reminded by the name of the *Cyrillae*, which the great Swede dedicated to his young Neapolitan correspondent. Indeed, the devotion of Cirillo for Linnæus was so great that, following the impulse of his enthusiastic nature, he raised a monument to him in the old botanical garden of the Cirillo family.

Induced by Lady Walpole, Cirillo visited France and England, becoming connected with D'Alembert, Diderot, Nollet, Buffon, Franklin, Sir John Pringle, and especially with William and John Hunter. He was elected a Fellow of the Royal Society. In 1771 he published in the *Philosophical Transactions* an account of the Manna Tree of Calabria, Sicily and Monte Gargano, describing the method of extracting the manna. The *Philosophical Transactions* also contain his observations, made near Taranto, on the effect of the tarantola bite; Cirillo confirms what Serao, in 1742, had already written on *Tarantism*, dispelling the absurd superstition of the music-cure supposed to be effected by dancing the Tarantella. He observes how in Sicily the tarantola is never dangerous, and the music-cure is unknown.[1]

In the latter part of the eighteenth century, while the Neapolitan kingdom was freeing itself more and more from the baneful Spanish influence, during the early years of the reign of Ferdinand IV. and Maria Carolina of Austria, a spirit of reform and progress had risen in South Italy, and a new impulse was given to research in natural sciences. In medicine, after Francesco Serao and Domenico Cotugno, Cirillo rose above the rest. The researches and teaching of Giovanni Maria Della Torre and of Cirillo opened a new field to the Neapolitan naturalists in microscopical investigations. And around Cirillo, again, a new school of botanists and zoologists and of chemical investigators arose, among whom we may record the names of Filippo Cavolini, Vincenzo Briganti, Gaetano Nicodemi, Antonio Barba, Saverio Macrì, Antonio Fasano, Nicola Pacifico, Vincenzo Petagna, Matteo Tondi, Nicola Andria, Vincenzo Comi. The discoveries of Alberto Fortis in 1783, near Molfetta, where he observed the richness of the soil in nitrates, led to investigations in Naples on the origin of nitre, in which Fortis himself, Melchiorre Delfico, Giuseppe Giovene, Giuseppe Vairo and Zimmermann were chiefly engaged. In geological and mineralogical research Giov. M. Della Torre took the lead, and with him, or shortly after him, worked Ascanio Filomarino duca della Torre, Domenico Salsano, Gius. Gioeni, Gaetano De Bottis, Luigi De Curtis, Vincenzo Santoli, Domenico Tata, Scipione Breislak, Camillo Pellegrini. In 1788 Lazzaro Spallanzani began his tour to the volcanic regions of Southern Italy and Sicily. In those days Sir William Hamilton, during the many years of his residence in Naples, collected information on the Phlegrean Fields, while Ascanio Filomarino was forming his Vesuvian Museum, destined to so short an existence; for the museum and all the other scientific collections in the Filomarino Palace were destroyed in January 1799, when the unfortunate duke and his brother, Clemente Filomarino, the poet (the translator of Young's poems), were burnt as Jacobins by the infuriated Royalist mob.[2]

During this same period some of the more important foreign works were translated into Italian and published in Naples; such as the works of Stephen Hales, of Priestley, Linnæus, and the Agricultural Encyclopædia of Rozier.[3]

Omitting here all mention of his medical and other publications, Cirillo's chief works on botany and entomology were the following:—"Tabulæ botanicæ elementares," 1773; "De essentialibus nonullarum plantarum characteribus," 1784; "Entomologia Neap. Specimen primum," 1787–1790; "De Cypero Papyro," 1787, re-edited at Parma in 1796; "Fundamenta botanica, sive philosophiæ botanicæ explicatio," 1787; "Plantarum rariorum Regni Neapolitani," fasc. i. 1788, fasc. ii. 1793; "Discorsi Accademici," 1789, re-edited in 1799.

In the field of vegetable physiology, the discoveries of Cirillo on the irritability of plants are noteworthy. In that field, together with his contemporary, G. B. Dal Covolo, Cirillo is the

[1] Ferrante Imperato, whose herbarium was preserved in the Cirillo collections, lived at the end of the sixteenth century. In writing his "Historia naturale," printed in Naples in 1599, Imperato put together a museum which soon became known in Europe; for besides having for fellow-workers in Naples B. Maranta and Fabio Colonna, Imperato corresponded with P. A. Mattioli, Gaspard Bauhin, Ulisse Aldovrandi, Melchiorre Guilandino, and others of the foremost botanists of the time. His herbarium is said to have been composed of eighty volumes. The museum of Imperato got dispersed during the plague of 1656, and Nicola Cirillo eventually obtained possession of only nine volumes. After the sacking of Domenico Cirillo's house in 1799, one volume only of the Imperato herbarium was saved, and is now in the Biblioteca Nazionale of Naples. It contains 440 dried plants, *i.e.* about one-seventh of all the plants identified in the days of Imperato and Bauhin. This herbarium, together with the herbarium of Cesalpino, is among the rarest of botanical relics.

Of the herbarium of Domenico Cirillo a small remaining portion is now preserved in the botanical museum of the Agricultural College of Portici, in the care of Prof. O. Comes.

[1] The music-cure for the tarantola bite is still practised by peasants, especially women, in some parts of the province of Lecce and in Calabria. In Cirillo's days the belief in the dangerous and strange effects of the bite of the tarantola was held even by persons high in authority. See Andrea Pigonati, "Sul Tarantismo," Opuscoli Scelti ii. (Milano, 1779). Compare Franc. Serao, "Della Tarantola o sia Falangio di Puglia" (Napoli, 1742).

[2] Duca della Torre, "Descrizione del Gabinetto Vesuviano da lui posseduto" (Napoli, 1796, 2da ed.).

[3] The works of Hales were translated by a lady, Maria Ardinghelli; St. Hales, "Statica dei Vegetabili ed Analisi dell' Aria, trad. dall' Inglese con varie annotazioni da M. A. Ardinghelli" (Napoli, 1756).

St. Hales, "Emastatica, ossia Statica degli Animali. Esperienze idrauliche fatte sugli animali viventi" (Napoli, 1776).

Gius. Priestley, "Sperienze ed Osservazioni sopra diverse Specie di aria, trad. dall' Inglese" (Napoli, 1784).

The translation of Rozier's Encyclopædia was begun in 1783, and was due to the Società Letteraria di Napoli, of which Cirillo was one of the leading members.

Vincenzo Petagna began editing the "Species Plantarum" of Linnæus.

direct successor of his celebrated compatriot, Alfonso Borelli, who, in 1653, discovered in Naples the irritability of the anthers of *Centaurea*, and of other Cynareæ. In his essay, "Del Moto e della Irritabilità dei Vegetabili," published in 1789, Cirillo briefly describes what was then known of the sleep of plants, of the movements of the leaf blade of *Dionoea muscipula*, and of the fly-trap concealed in the flowers of *Aposynum androsaemifolium*, a plant then lately studied by Francesco Bartolozzi in Milan.[1] Cirillo quotes Linnæus' description of the movements of the *Hedysarum gyrans*, first discovered by Pohl in 1779. After describing the irritability of the stamens of the Cynareæ, the gradual sensitiveness of the flowers of Verbascum to shocks, and the recent observations of Duhamel and of others on the stamens of *Berberis*, and of *Parietaris officinale*, Cirillo goes on to describe his own discoveries of irritability in *Forsckohlea tenacissima*, and in the common nettle, *Urtica dioica*. "The study of the very complex fructification of the first plant (*Forsckohlea*) having revealed to me the spiral structure of the filaments, similar to those of *Parietaria*, I was led to verify whether these filaments also possessed irritability. It is of great interest to observe in the nettle, during the warmer morning hours, how the male flowers open abruptly, and suddenly burst open their well-closed anthers, that eject abundant fertilising dust."[2]

These observations brought Cirillo to believe that the "marvellous irritability of the sensitive plant, as well as the elasticity in the stamens of flowers, must be partly due to the spiral structure of the organs in which the contractions take place, chiefly, however, to the very frequent articulations of which these parts, so mobile and so irritable, are essentially composed."

Hedwig had in these years opened the way to the knowledge of mosses; and Cirillo again observed cases of irritability and elasticity in the capsules of mosses and in the filaments they contain, the articulated structure and the spiral form of which again confirmed his opinion on the mechanism of plant movement.[3]

In studying the sensitive plant, Cirillo points out the enlargement at the insertion of each leaf; and observing what he believed to be a spiral structure within this "tubercle-like body," suspects a connection between the spiral structure and leaf-movement. Comparing the *Mimosa pudica* with the *Mimosa glauca*, Cirillo finds that the great difference in their sensitiveness corresponds with the different size and development of the articulations containing the spiral structure. This *spiral structure* corresponds, of course, with the fibro-vascular bundle inside the *pulvinus*, the motor organ, in which, as we now know, the sap tension suddenly sinks at every cause of irritation.[4]

Following the ideas of Haller, the first to have a notion of protoplasm as the physical basis of life, Cirillo believes that the seat of irritability and of life, both in animals and in plants, must be in mucilaginous substances. Thus he points out that in plants "glutinous principles" are commonly met with which must be the seat of motion, of contraction, and of irritability. Curiously enough, as an example of this glutinous principle, Cirillo gives the "elastic resin now used so extensively" extracted from the sap of *Jatropha elastica*, and existing, as he observes, in many other plants. In that time, when only impure rubber was in commerce, it had been observed that this substance, besides strongly-smelling empyrheumatic products, yielded ammonia by distillation; it was therefore generally considered of the same nature as glutinous animal substances.[5]

[1] Fr. Bartolozzi, "Sopra la qualità che hanno fiori della pianta detta Apocynum Androsæmifolium di prendere le mosche, con una osservazione nuova sulla fecondazione delle piante," Opuscoli Scelti ii. (Milano, 1779, p. 103; and iv. 1781, p. 73).

[2] Besides G. B. Dal Covolo, "Discorso della irritabilità di alcuni fiori, nuovamente scoperta" (Firenze, 1764), compare with the observations of contemporary botanists—G. E. Smith in England, and Des Fontaines in France. An abridgment of these observations was published in Italian at Milan: Des Fontaines, "Sull' Irritabilità degli organi sessuali di molte piante," Opuscoli Scelti x. 1787, p. 417; G. G. Smith, "Sopra la irritabilità dei vegetabili," Op. Scelt. xi. 1788, p. 379.

[3] See also Antonio Barba, "Osservazioni sopra la generazione dei Muschi," Op. Scelt. v. 1782, p. 128. Barba was a pupil of Cirillo and of Della Torre.

[4] See also Andrea Comparetti, "Nouvelles Recherches sur la Structure organisée relativement à la cause des mouvements de la sensitive commune" (*Mém. Acad. de Turin*, 1790).

[5] It is interesting to remember that in those days, in London, Tiberio Cavallo was first beginning to prepare india-rubber tubing for scientific use, the tubes being made from an ethereal solution of the india-rubber. See Faujas St. Fond, "Su alcune arti utili, tratte da un viaggio in Inghilterra, in Scozia, e alle Isole Ebridi," Op. Scelt. xx. 1797, p. 60.

For the first applications of india-rubber in making waterproof cloth, &c., and for a description of Grossard's method of making india-rubber tubes, see Cervantes, "Resina Elastica," Op. Scelt. xxi. 1798, p. 97.

The researches of Hunter, showing the connection between nerve-action and electricity in the torpedo, and the experiments that Cirillo's friend Italisckhi was making in Naples on the electrical organ of the torpedo, brought Cirillo to believe that there must be some special connection between electricity and the action of nerves, and in general with all manifestations of irritability. As is well known, that was an active period of research on the torpedo: suffice it to record the names of Walsh, Pringle, Spallanzani, Soave. At Naples, in 1784, Domenico Cotugno accidentally received an electric shock in vivisecting a young mouse: this on the eve of Luigi Galvani's discoveries in animal electricity. This was also the period of greater fervour in experimenting upon the influence of electricity on vegetation. These experiments were chiefly carried out by Achard in Germany, Berthelon in France, Toaldo, Gardini and Vassalli in Italy and by Ingen-Housz in England. Vassalli and Rossi were soon to show the excitability of the sensitive plant under electric action.[1]

The connection of the chemical action of atmospheric air with respiration, and with all forms of animal and vegetable motion, was evidently in the mind of Cirillo. Indeed, for many years scientific research in Italy, both on animal and vegetable life, had been discovering more and more this connection, preparing the way to modern knowledge of respiration and of the origin of vital heat and of vital motion.

Fracassati, in 1665, had observed the change of colour in blood when shaken up in air. The experiments of John Mayow, the pre-discoverer, if the term may be used, of oxygen, were perhaps better known and appreciated in Italy than in England, through Ludovico Barbieri, of Imola, who translated and extended the work of the English chemist. Barbieri observed that the bright colour of arterial blood must be due to impregnation with nitro-aërial spirit; and he showed, by experiments on the transfusion of blood into an animal prevented from breathing, the truth of Mayow's teaching, that atmospheric nitro-aërial spirit, fixed in the blood, sustains life and, as in the case of the flame, produces heat. Barbieri also taught that the nitro-aërial spirit of the air causes the germination of seeds and sustains the life of plants.[2]

Hales, during the first part of the eighteenth century, had shown how plants suffer when enclosed in gases other than air, as the "air" extracted by distillation from Newcastle coal. Bonnet and Duhamel observed subsequently that leaves perish when covered with oil. But to Buonaventura Corti, the discoverer of protoplasmatic movements in the vegetable cell, is due the first exact proof of respiration in plants. Corti showed, in a series of experiments, that when air is excluded from the vegetable cell all circulation of the cell-sap is arrested: "now that we have shown," he observes, "that the circulation of the sap of the Chara is arrested when *in vacuo*, we readily understand why all plants perish without air, and why seeds cannot germinate without air, or perish shortly after sprouting."[3] In those days, in 1773, Francesco Cigna, in Turin, was again proving the action of air upon the colour of blood, and the influence of blood upon the properties of air. Cigna's experiments were repeated with greater exactitude, after the discovery of vital air, by Priestley, who showed that vital air, *i.e.* oxygen, causes the blood to brighten, while its colour deadens in contact with other gases. The discoveries of Priestley were followed, in 1779, by Adair Crawford's theory and experiments on respiration and animal heat.[4] According to Crawford, the latent heat of atmospheric air gradually becomes perceptible as animal heat, while the air absorbed through the lungs gets mixed and retained in the blood, which yields its phlogiston to the atmosphere. Crawford held that vegetable matter is elaborated, and becomes charged with phlogiston, under the action of solar rays; whilst during the combustion of vegetable matter phlogiston is again yielded up to the atmosphere and fire generated, in the same way blood generates heat, while phlogisticating expired air. Vegetables again, growing under the influence

[1] Cotugno's observations on the electrical mouse are described in a letter to Vivenzio. See Tiberio Cavallo, "Teoria e Pratica dell' Elettricità Medica" (Napoli, 1784, p. 157). This is an Italian translation by Vivenzio; the original English work was published by Cavallo in London, in 1780.

[2] "Planta a spiritu nitro-aereo prima vitæ stamina suscipit," wrote Barbieri in 1680. See Salvigni, "Ragionamento sopra alcune dottrine chimiche di Giovanni Mayow e di Ludovico Barbieri" (Bologna, 1816).

[3] B. Corti, "Osservazioni microscopiche sulla Tremella e sulla circolazione del fluido in una pianta acquajuola" (Lucca, 1784, p. 191).

[4] An Italian abridgment of Crawford's paper was published very soon after its appearance in England: Adair Crawford, "Sul calore animale e sull' infiammazione dei corpi combustibili," Opuscoli Scelti iii. 1780, p. 73.

of light, separate phlogiston from the tainted air, and repristinate in the atmosphere the power of generating heat by combustion or by respiration. A cycle of the principles of heat and of phlogiston is thus maintained through atmospheric air between the vegetable and animal kingdoms. Substituting the old conception of phlogiston by the modern idea of energy, we perceive in Crawford's theory the germ of the theory of the preservation and transformation of energy. Crawford's work prepared the way, as Carradori pointed out in 1792, to Lavoisier's experiments on respiration, and for the ready acceptance of his theory.

In Italy, where the experiments of Marsiglio Landriani, of Pietro Moscati and of Lazzaro Spallanzani, were then showing the influence of different gases on cutaneous respiration, and where Spallanzani was demonstrating the evolution of fixed air even from tissues separated from the living body, and in organisms prevented from absorbing free vital air, the theory of Crawford was readily accepted, and served as a starting-point to the experiments of Michele Rosa in Modena. Rosa, indeed, followed directly in the track opened by Ludovico Barbieri a century before. By a numerous series of experiments in transferring arterial blood into animals prepared by copious bleeding, and by the different comportment of arterial and venous blood *in vacuo*, Rosa showed that the vital principle has its seat chiefly in the blood, and is maintained by the continuous action of atmospheric air during respiration, being due to the same cause that maintains combustion. Rosa's work has not been sufficiently appreciated because of his misapplication of names, and was too soon forgotten in the great light shed by the experiments of Lavoisier; but there is no doubt that to Rosa is due the first demonstration of the incorporation of oxygen in the blood, of the special labile condition of its combination, and of the supreme importance of aëration for the vitality of all animal tissues.[1]

When Cirillo wrote his essays, the theories of Crawford and of Rosa were in their bloom, and were warmly espoused by the Neapolitan naturalist. Cirillo believed that all life, animal and vegetable, had its origin in the action of air upon the "glutinous principle," that is, the basis of life in all tissues, and that light, electricity and heat, but especially solar light, are all connected with the quickening of life. Like Lavoisier, Cirillo looked upon sunlight as the origin of all life: "Sunlight," he wrote, "the only, the inexhaustible, primitive and incomprehensible fount that pours heat and motion and life upon our globe."

John Hill, in his letter to Linnæus in 1753, had shown the special connection of light, independently of heat, with the sleep-movements of plants. Priestley's celebrated experiments on the purifying action of vegetation upon air vitiated by respiration, or by combustion, had been known since 1772. In 1779 Ingen-Housz pointed out that this action of plant-life is due to sunlight, and only takes place when light acts upon green plants. Cirillo himself must have observed the attraction of lower organisms towards light, similar to those swarm-spore movements that shortly after were first described by Giuseppe Olivi.[2] "Why," asks Cirillo, "do all polyps love light, so that, on darkening the vase in which they are contained, leaving free only a tiny hole, they all forsake darkness, and throng near the spot where they can enjoy the immediate action of the solar rays? Why are all marine animals so filled with a luminous vapour, emitting phosphoric light? Why are the most irritable fish phosphorescent and electric? Why do plants, when deprived of solar light, lose colour, aroma and robustness?" Cirillo, like most of the writers of his time, was not clear in the distinction between light and heat; but what is predominant in his mind is that all movement, both in animals and in plants, is due to fixation of vital air, to oxidation, and that light therefore, by causing the sleep-movements in plants, must be connected with some process of oxidation.

While Cirillo was writing, Senebier had already shown (1788) that the chief action of light in plants is the reverse of oxidation, causing the decomposition of carbonic acid and the evolution of oxygen. The importance of this discovery, and the mistaken notions about plant-respiration, caused what may be called the minor functions of light in plants to be neglected. Only long after the days of Cirillo and of Senebier, in the latter part of our century, investigations began on the influence of light in respiratory processes: in the decomposition of chlorophyll, in changing the composition of the sap, and the distribution of osmotic tension, and consequently in causing the movement of plant-organs, as in the case of nyctitropic and heliotropic movements. These changes are promoted, as was first shown by Michelangelo Poggioli in 1817, by the more refrangible rays of the spectrum, by those rays, namely, that are specially active in causing the oxidation of organic compounds and in decomposing silver and other salts.

Cirillo's opinions on the chemical activity of solar rays were due to his own original observations on the chemical action of sunlight upon silver chloride. His experiments were made to test the truth of an assertion by Nicola Andria that certain Ischia waters contained phlogisticated alkali (yellow prussiate), and could consequently produce Prussian blue.[1] "A curious phenomenon," Cirillo writes, "has been recently observed by me whilst analysing the Olmitello water of the Island of Ischia. Investigations of our chemists had brought them to believe that this water contained a phlogisticated alkali, similar to that prepared from the colouring matter of Berlin blue; for, on mixing the water with some *luna cornea*, or with a solution of silver in nitrous acid, not only was a white substance instantly produced, but after a short time it changed to a very beautiful and dark azure colour. This experiment, seeming to show the existence of a phlogisticated alkali in the Olmitello water, having been accidentally repeated by me towards evening, I observed that the mixture remained white during the whole night, becoming azure only on the following morning, after the rising of the sun. I also noted that the intensity of the azure colour in the sediment increased with the growing intensity of sunlight. These results led me to repeat the experiment while excluding all action of light. To half a glass of Olmitello water I therefore added a few drops of the solution of silver in nitrous acid; and as soon as the white precipitate due to the alkali was formed, I shut the glass in a place utterly impenetrable to light. For many days the precipitate remained white; but on exposure to light it became cerulean in a few minutes. The same change was observed in a water from Calabria; for, on treating it as the Olmitello water, it also rendered blue the *luna cornea*. Also our common waters, probably charged with an alkaline earth, undergo the same change. I am aware of what recent writers have said about the repristination of metals by solar heat; nor do I ignore how with a burning lens the illustrious Priestley, heating inflammable air in contact with minium inside a glass vessel, was able to repristinate lead. But my experiment will serve at least to correct the error of those who analysed the Olmitello water, believing it to contain a phlogisticated alkali, similar to the Prussian alkali; and secondly, this experiment gives us a sure proof of the energy of solar rays in repristinating metals. These observations, although having a distant connection with the movements and irritability of vegetables, are also worthy of record in connection with other considerations which I hope shortly to publish."

Cirillo's essay was published, in its first edition, in 1789, so that the Olmitello experiments must have been made shortly before that year and after Andria's last publication of 1783. As is well known, the experiments of Scheele (not counting the earlier, forgotten experiments of J. H. Schultze in 1727) were published in Swedish in 1777; a French translation, by Baron Dietrich, of Scheele's treatise on Air and Fire appeared in Paris in 1781.[2] Scheele's experiments on *luna cornea* and other silver salts are quoted and commented upon by Felice Fontana in 1783.[3] Senebier, in 1782, had been experimenting on the rapidity of action of different lights upon silver chloride.[4] Cirillo therefore ought to have been acquainted with Scheele's experiments, although there is every reason to believe that he, generally so precise in recording previous work, was not aware that, only a few years before his own experiments with the Ischia water, the action of light upon silver salts, and especially

[1] Michele Rosa, "Lettere fisiologiche," 3da ed.; "Colle osservazioni ed Esperienze sul Sangue fluido e rappreso dal Signor Pietro Moscati," 2 vols. (Napoli, 1788).

This edition is dedicated to Domenico Cirillo. The experiments of Rosa were first published in Vicenza in 1782. The experiments of Lavoisier on animal respiration, first published in Paris in 1777, appeared in Italian in 1781 (Opuscoli Scelti iv. 1781, p. 135).

[2] Giuseppe Olivi, "Delle Conferve irritabili, e del loro movimento di progressione verso la luce, Esame chimico" (*Mem di Mat. e Fisica della Soc. Italiana*, tom. vi. Venezia, 1793).

[1] Nicola Andria, "Trattato delle acque minerali," 2da ediz (Napoli, 1783).

[2] Ch. Giul. Scheele, "Traité chymique de l'air et du feu." Trad. Dietrich. (Paris, 1781).

[3] Felice Fontana, "Sopra la Luce, la Fiamma, il Calore, ed il Flogisto" (Opusc. Scelti vi. 1783).

[4] Jean Senebier, "Mém. physico-chymiques sur l'influence de la Lumière Solaire, pour modifier les êtres des trois règnes de la Nature" (Génève, 1782).

the action of the more refractive rays of the spectrum, had been demonstrated and studied by the highest chemical investigator of the time, who had died in 1786. Cirillo's observations are, however, worth recording, because they were connected in his mind with the action of sunlight in causing movements and irritability in vegetable organs.

Other workers in those days were investigating in Italy the chemical action of light; and their experiments, like those of Cirillo, are also generally forgotten. In 1782, Alessandro Barca, in Padua, studied the effect of solar rays in accelerating the decomposition of phlogisticated alkali, or yellow prussiate, in the presence of acetic acid.[1] In 1794, Anton Maria Vassalli, in Turin, in comparing the action of solar and of artificial light, showed that the latter darkens silver salts, causes chlorotic leaves to become green, rouses the sleeping leaves of the sensitive plant, and acts generally in the same manner, although with less intensity, as the light of the sun. Vassalli observed a diminution in weight in the silver chloride darkened by light; he also experimented upon the effect of moonlight upon this salt, and upon vegetation.[2]

The "Discorsi Accademici" of Cirillo, in which are the two remarkable essays, "Del moto e della irritabilità dei vegetabili" and "La cagione della vita," were first published in 1789, and re-edited in 1799. This second edition was the last scientific labour of Cirillo, for in that same year he was overwhelmed in the political storms that swept over Naples. All the writings of Cirillo glow with warm philanthropy and patriotism, and we see in them a constant protest against the prejudices and superstitions then so high in authority in the Neapolitan kingdom. After the cowardly flight of King Ferdinand from Naples in December 1798, leaving the city a prey to royalist anarchy, Cirillo joined with the patriots who favoured the entrance of the French into Naples and the establishment of the Parthenopæan Republic. Pressed by the insistance of his friends, Cirillo accepted the presidency of the legislative body, but during the brief period of his political power he occupied himself mainly in alleviating the growing misery of the people; above all, Cirillo remained the philanthropist and the physician rather than the politician. The Republic lasted a few months, sinking finally in the struggle with the brigand hordes of the Holy Faith, that through pillage and bloodshed Cardinal Ruffo led from Calabria to Naples. Cirillo was among the many who capitulated in the Castles of Naples, on condition of a free passage to a French port. The sorrowful history of what followed is well known, of how the capitulation was ruthlessly broken when Castles and prisoners were secured. All those who had held office under the Republic, or had any direct connection with its government, were condemned to death for high treason. From June 29, 1799, to September 1800, execution followed execution, until in Naples alone ninety-nine of the foremost men were put to death, besides the many—it is said 300—executed in the provinces. Domenico Cirillo was hanged on the same day as Mario Pagano and the poet Ignazio Ciaja. "For the death of these men all the city mourned," wrote Marinelli, a diarist of the time. Another botanist, Abate Nicola Pacifico, an old man of seventy, companion and fellow-worker of Cirillo, shared his fate on August 20, on the same day when the gifted Eleonora Fonseca Pimentel was delivered to the hangman.

Cirillo's house was pillaged by the mob, and his collections and books, among which was the herbarium of Imperato, were burned or dispersed. "Let the idle and ignorant know that love of humanity, zeal for science, and faithfulness to duty can only be quenched in me with my life"—thus wrote Cirillo in the days of his prosperity, little dreaming of the distant purport of his words. Nobly indeed, when oppression and ignorance prevailed, in the days of suffering and agony, Cirillo to the very last kept faith to duty and to Fatherland.

ITALO GIGLIOLI.

METALLIFEROUS DEPOSITS.

A COURSE of four Cantor Lectures delivered before the Society of Arts by Mr. Bennett H. Brough, on the nature and yield of metalliferous deposits, has just been published. Descriptions are given of the principal ore deposits of the world, and the statistics of production appended furnish a clear idea of the condition of the mining industry at the present time. The subject is of great importance from a commercial point of view, as will be evident from a moment's consideration of the enormous value of mineral resources. In the United Kingdom alone, the value of the minerals raised in one year has approached 80,000,000*l*.; and the vast sums representing the British capital invested in mines in all parts of the world will be readily appreciated. Last year, the number of new mining companies registered in Great Britain was 559, with a united nominal capital of 71,687,366*l*. Of these companies, 281, with a nominal capital of 37,037,057*l*., were formed to mine and explore in British colonies and dependencies, and 157, with a nominal capital of 24,049,502*l*., to mine in foreign countries. During the present century the mining industry has made remarkable strides. Some indication of the progress made, even during the past ten years, is afforded by a comparison of the world's output of metals in 1889 and in 1898. In round numbers, the production of the principal metals was as follows:—

	1889. Tons.	1898. Tons.	Value of output in 1898. £
Pig-iron ...	26,000,000 ...	36,000,000 ...	100,000,000
Gold	182 ...	430 ...	57,500,000
Silver	3,900 ...	6,000 ...	24,000,000
Copper... ...	266,000 ...	431,000 ...	21,750,000
Lead	549,000 ...	770,000 ...	10,000,000
Zinc	335,000 ...	468,000 ...	9,950,000
Tin	55,000 ...	77,000 ...	8,000,000
Antimony ...	11,000 ...	28,000 ...	1,100,000
Mercury ...	3,838 ...	4,100 ...	815,000
Nickel	1,830 ...	6,200 ..	725,000
Aluminium ...	70 ...	4,000 ...	440,000

The simplest classification of the ore deposits from which these vast outputs have been obtained, divides them into (1) beds, (2) veins, and (3) masses. This classification has proved well adapted for practical use. The more elaborate systems of classification that have from time to time been proposed are fully discussed, the classifications dealt with being those of Agricola (1555), Burat (1855), B. von Cotta (1853), Grimm (1869), J. A. Phillips (1884), A. von Groddeck (1878), F. Pošepný (1880), Sir A. Geikie (1882), H. S. Monroe (1892), H. F. Kemp (1892), H. Louis (1896), H. Hoefer (1897) and G. Gürich (1899). The last-named investigator uses the mode of concentration as the basis of classification. The concentration may take place with or without a change in the state of aggregation. In the former case the passage into the solid state is from a state of vapour, from a molten state, or from a state of aqueous solution. Consequently the following classes of ore deposits are distinguished:—

I. Sublimation deposits: (*a*) syngenetic, in which the sublimation of the vapours takes place simultaneously with the solidification and within a solidifying magma, *e.g.* tin ore deposits; (*b*) epigenetic, in which crusts are formed coating fissures; (*c*) metagenetic, in which the constituents of a rock are dissolved by pneumatolysis and replaced by metallic substances.

II. Magmatic, or solidifying deposits: (*a*) syngenetic, representing the usual form of magmatic deposit as described by Vogt; (*b*) epigenetic, only imaginable if an apophysis of a magma within the enclosing rock consists of a metallic band; (*c*) metagenetic, hardly imaginable.

III. Precipitation deposits: (*a*) syngenetic, in which the chemical precipitation takes place simultaneously with the sedimentation, the deposit being formed simultaneously with the surrounding rock, *e.g.* seams, beds; (*b*) diagenetic, in which the concentration takes place in the muddy floor of a lake, *e.g.* concretionary nodules of clay iron ore; (*c*) epigenetic, in which the deposit is formed subsequently to the surrounding rock, *e.g.* veins, cave fillings; (*d*) metagenetic, in which the soluble constituents of a rock are dissolved, transported, and the metallic substance precipitated, the deposit being formed subsequently to the enclosing rock, but growing at the expense of the latter.

IV. Separation deposits: (*a*) residual deposits formed by chemical concentration, a soluble rock constituent, *e.g.* lime, being carried away, and a metallic substance, *e.g.* brown iron ore, remaining unaltered; (*b*) detrital deposits formed by mechanical concentration, *e.g.* dry placers, alluvial deposits.

In view of the apparent impossibility of definitely determining the genesis of a given deposit, it may be questioned how far it is advisable to adopt a genetic classification. Probably, however, by employing that system of classification, an observer would be induced to make a more thorough examination than if he were

[1] Alessandro Barca, "Sulla Scomposizione dell' alcali flogisticato" (Opusc. Scelti vii. 1783).

[2] Anton M. Vassalli, "Parallelo della Luce Solare e di quella della combustione" (Opusc. Scelti xvii. 1794, p. 106).

required merely to define the deposit by its outward form. Any efforts to introduce improvements in mining must, however, subordinate theory to practical requirements.

In consequence of the difference of form in beds, veins and masses, various methods of working have to be employed. Underground mining is not necessary with all ore deposits. The iron ore beds of Northampton, for example, and the alluvial beds of river gravel containing gold are worked open-cast.

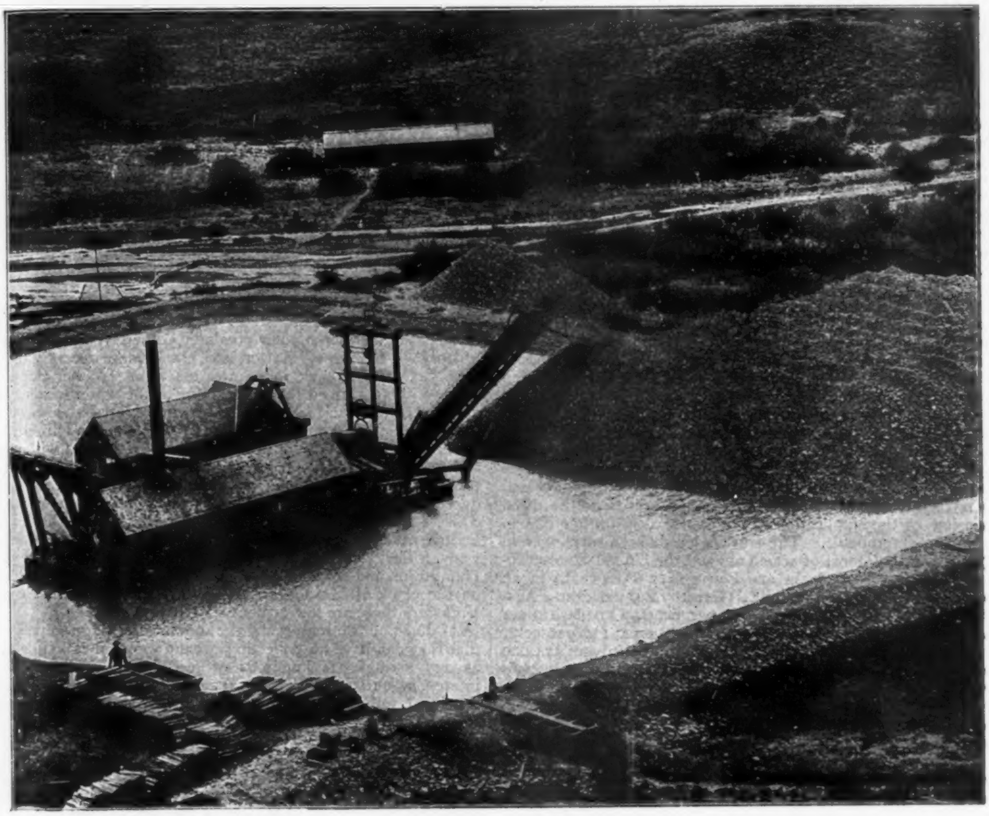

FIG. 1.—Gold Dredge at work excavating auriferous Gravel 45 feet below the Water Surface.

Of late years very successful results have been obtained by extracting auriferous gravels from the beds of rivers by dredges. The practice of dredging originated and has been brought to its present state of perfection on the Clutha river, in the province of Otago, New Zealand. Ground containing only a grain or a grain and a half of gold per cubic yard can now be worked at a profit. The remarkable yield of a dredge working at Cromwell, on the Clutha river, which cost 5,000*l*. to build and launch, and obtained more than that amount of gold within seven weeks after starting, shows how quickly the capital sunk in the industry has, in some instances, been returned. Experience in Montana, United States, shows that with a bucket-dredge 98 per cent. of the gold in the gravel is extracted. The cost of dredging when steam is employed is $4\frac{1}{2}d$. per cubic yard, and when electricity is employed for power $2\frac{1}{4}d$. per cubic yard. The practice of dredging is coming into increasing use in New Zealand, Canada, California, Montana, the Republic of Colombia, and elsewhere. It represents an important advance in the working of alluvial deposits, and if the yields of gold in the future are not likely to be so sensational, they will probably be more regular than they have been in the past. The accompanying illustration (Fig. 1) shows the latest type of gold dredge made by the Risdon Iron-works of San Francisco. As represented, it is excavating auriferous gravel 45 feet below the water, and stacking it 24 feet above.

The gradual increase in the world's annual production of gold is shown in the accompanying diagram (Fig. 2).

The value of the world's gold production in 1898 was 57,500,000*l*., of which the Transvaal produced 27·6 per cent., Australasia 22·5 per cent., the United States 22·1 per cent., Russia 8·8 per cent., Canada 4·8 per cent., Mexico 3 per cent., India 2·7 per cent., and China 2·1 per cent. Thus the Transvaal, Australasia, and the United States together produced 72 per cent. of the total. The production last year was even greater, amounting probably to 62,700,000*l*., notwithstanding

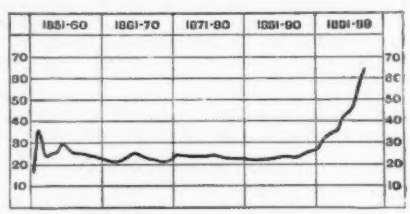

FIG. 2.—World's gold production (in millions of pounds).

the interruption in Transvaal mining. From the present condition and prospects of the more important mines in Africa, Australasia, the United States, Canada and other countries, it seems that there are no signs of falling off in the world's gold

production. In the case of silver, of which the world in 1898 produced 165,000,000 ounces, Mexico produced 34·4 per cent., the United States 33 per cent., and Australasia 7·3 per cent. Less than half the world's supply was obtained from silver ores. The remainder was obtained from the metallurgical treatment of other ores in which silver was an accessory constituent. Since those ores would continue to be mined for the other metals they contained, a steady supply of silver was assured, whilst a slight rise in the price of silver would enable many deposits of true silver ores now untouched to be worked.

In a paper read before the Society of Arts in 1854, Mr. J. K. Blackwell stated that the world's production of pig iron then amounted to 6,000,000 tons. Of that quantity the United Kingdom produced 50 per cent., France 12·5 per cent., the United States 12·5 per cent., and Germany 6·6 per cent. In 1898 the world's production had risen to 35,741,000 tons, of which the United States produced 32·7 per cent., the United Kingdom 24·1 per cent., Germany 20·6 per cent., and France 7·1 per cent. The relative position of the different countries from a mining point of view is better shown by the statistics of iron ore production. The world's production in 1898 was 73,670,000 tons, of which the United States produced 26·2 per cent., Germany 21·6 per cent., the United Kingdom 19·3 per cent., Spain 9·7 per cent., France 6·2 per cent., Russia 5·6 per cent., Austria-Hungary 4·5 per cent., and Sweden 3·1 per cent. The more important iron ore deposits now worked are at the mines of Lake Superior, Bilbao, Southern Spain, the Ural, Styria, Dannemora, Grängesberg and Gellivare.

With regard to copper, the rapid decadence of British copper mining was owing to copper in the Cornish mines having given place to tin as greater depths were reached, and to these great depths and the quantity of water encountered rendering competition with the American and Spanish deposits impossible. There are, however, large areas unexplored, and many mines worth re-opening should the price of copper rise, and should the disadvantages experienced in Great Britain make themselves felt abroad. Owing to the increased demand for copper caused by the rapid extension of the applications of electricity, a further rise in price is not improbable. The world's production of copper in 1898 was 424,126 tons, of which amount the United States produced 55·1 per cent., Spain and Portugal 12·6 per cent., Japan 5·9 per cent., Chili 5·8 per cent., Germany 4·9 per cent., Australasia 4·2 per cent., Mexico 2·5 per cent., Canada 1·9 per cent., Cape Colony 1·6 per cent., and Russia 1·4 per cent. Last year the world's copper production was about 474,000 tons. The Anaconda Mine produced 11 per cent. of the world's output, and among other important copper mines are those in Arizona, in the Lake Superior district, in the South of Spain (Rio Tinto and Tharsis), and Portugal (San Domingos), in South America, in Japan; at Mansfeld, and at the Rammelsberg, in Germany; at Falun, in Sweden; and in Australasia (Mount Lyell, Tasmania; Moonta and Walleroo, South Australia; and Great Cobar, New South Wales).

CONFERENCE OF DELEGATES OF CORRESPONDING SOCIETIES OF THE BRITISH ASSOCIATION.

THE first meeting of the Conference took place at Bradford on Thursday, September 6.

The report of the Committee, a copy of which was in the hands of every delegate present, was taken as read. The chairman then remarked that the chief subject for discussion that day consisted of the following resolutions, which had been brought forward by the Yorkshire Naturalists' Union:—

(1) That the Conference of Delegates be allowed to meet on the first day of the British Association meeting, and make their own arrangements for subsequent meetings and order of business.

(2) That it is desirable, in order to make the discussions of the Conference of Delegates more useful to the local societies, that they should have the power of deciding the subjects for discussion at the meetings of the Conference, and it is suggested, therefore, that a circular be sent by the Committee every year to each of the corresponding societies asking them to send a list of subjects for discussion (not more than two or three) at the forthcoming meetings. The Committee then to send to the corresponding societies a schedule containing the titles of all the subjects proposed for discussion, asking each society to mark such of these subjects as it deems most desirable to discuss at the Conference meetings. On receipt of this information the Committee will then arrange the list of subjects in order of precedence as indicated by the support given to each subject by the societies; and a copy of this should be sent to the delegates or Societies as an agenda paper before the first meeting of the delegates.

After a long discussion, it was resolved that the meetings of the Conference be held on Thursday and Tuesday, as heretofore.

Copyright.—Mr. Walton Brown remarked that some time ago Lord Monkswell had introduced a Bill into Parliament dealing with copyright, but so far as scientific societies were concerned the Bill ignored some important points. There was no provision that a society should have any copyright in the publication of its own transactions. He believed that societies could claim copyright if they paid their contributors. He thought that the Conference should ask the Corresponding Societies Committee to take steps to have an amendment proposed recognising the copyright of scientific societies in their publications.

Prof. Henry Louis pointed out that the British Association expressly disclaimed copyright for themselves; and the Rev. J. O. Bevan urged that a special case should be prepared and submitted to counsel for a legal opinion. Mr. Walton Brown's views were unanimously accepted by the meeting, which then adjourned.

At the second meeting of the Conference an address on dew-ponds was given by Prof. Miall. In the first place, Prof. Miall noticed the mention of dew-ponds by Gilbert White ("Natural History of Selborne," Letter lxxi.), and more recently by the Rev. J. C. Clutterbuck in a prize essay on "Water Supply." Both writers described them as existing on the tops of chalk hills, and Mr. Clutterbuck says that at the selected spot an excavation is made from 30 to 40 feet or more in diameter, and from 4 to 6 feet deep. The bottom is covered with clay mixed with lime, and a layer of broken chalk is placed over the clay with lime to prevent injury to this impermeable lining. Water is then introduced by artificial means. If there is a fall of snow this is collected and piled in the pond. Ponds so made have been known never to become dry during periods of twenty or thirty years. They are most common on the chalk hills of Sussex and Hampshire, and are also found in Berkshire and Wiltshire. But on the chalk of Hertfordshire, Bedfordshire, Lincolnshire and Yorkshire there are few or none.

As dew-ponds often occupy the summit of a ridge so precisely that they can have no collecting ground worth mentioning, and as any springs are hundreds of feet below, it becomes an interesting question why they retain more or less water when the low-level ponds of the same district have become dry, though they supply water for large flocks of sheep.

Prof. Miall then reviewed the evidence bearing upon the question whether these ponds are mainly dew-ponds or rain-ponds, and quoted the experience of Mr. Clement Reid, who found that at the end of a long drought the best dew-ponds were sheltered on the south-west side by an overhanging tree, or the hollow was sufficiently deep for the south bank to cut off much of the sun. The depth or shallowness of the water did not appear to make so great a difference as might be expected.

It was, however, evident that many additional observations were necessary before this question could be settled. It was desirable that the temperature of the water of the pond at various depths, as taken hourly through a summer night, should be noted, and that many other thermometrical observations should be made. He concluded by asking that residents in the south-eastern counties would investigate the matter.

Mr. Clement Reid had been working for some years in a country where dew-ponds were abundant, but did not think they were formed in the scientific manner pretended by their makers. In times of drought some dried up and others did not, the fittest surviving. Farmers were continually making new ones, and sometimes, by accident, hit on a satisfactory site. It was unfortunate that they were almost entirely without meteorological observations on the high ground where dew-ponds might be seen.

Mr. Hopkinson noted the difficulty of ascertaining the amount of water contributed to the pond by dew. A distinction must be drawn between dew and mist. There were scarcely any rain gauges on the high ground where dew-ponds existed, though probably more rain fell there than in the valleys. He did not know of any dew-ponds in Hertfordshire. Mr. J. Brown and Mr. W. Gray stated that there were no dew-ponds in Ire-

land. Mr. W. M. Watts considered that the amount of dew could hardly exceed $1\frac{1}{2}$ inches per annum, and Mr. Barrowman was not aware of the existence of dew-ponds in Scotland. Mr. G. P. Hughes said that dew-ponds were unknown in his district (Berwickshire). He thought they might prove useful in Australia and South Africa, dry countries where the dews were heavy. The Rev. E. P. Knubley noted their existence in Wiltshire, and Prof. H. Louis thought that the exact composition of the water in these ponds was one of the essential points to be examined. Prof. Potter noted the existence of ponds in Warwickshire, Suffolk and the South of Portugal, which he thought might prove analogous to dew-ponds.

Prof. Miall referred to various points which had been raised in the discussion. Ponds to be classed with dew-ponds must not be fed by springs or surface drainage. He had hitherto found that ponds in the Midland counties, supposed to be analogous to dew-ponds, were not really so. He hoped that the corresponding societies would take up the subject.

Section C.—Mr. Monckton, representing Section C, drew attention to the labours of two committees wishing to obtain the co-operation of the corresponding societies in their work, the Geological Photographs Committee and the Erratic Blocks Committee. The secretary of the Geological Photographs Committee was Prof. W. W. Watts; the secretary of the Erratic Blocks Committee Prof. P. F. Kendall.

Section D.—The Rev. E. P. Knubley, representing Section D, was anxious that the corresponding societies should go on observing the migration of birds; also the food-supply of birds and the life-histories of insects.

Section H.—Mr. E. Sidney Hartland, representing Section H, brought before the Conference the work of the Anthropological Photographs Committee. That committee wished to collect photographs of objects of anthropological interest which were now scattered over the country, and almost unknown outside their own localities. They wanted photographs of prehistoric stone monuments and implements, of primitive pottery and of objects connected with local superstitions. The collection would be placed in the rooms of the Anthropological Institute. The secretary of the committee was Mr. J. L. Myres.

The Rev. J. O. Bevan urged the committees of the corresponding societies to lay before their members the desirability of a systematic survey of their counties with respect to their ethnography and ethnology, archæology, folklore, meteorology, botany, ornithology, &c. This kind of work was being done in part at various places. The committee of the British Association which had been concerned with ethnography and ethnology had been dissolved at the Dover meeting. He hoped that the local societies would take up the work, and inform the Corresponding Societies Committee what was being done.

After a few remarks from Mr. Hembry, who suggested that at future meetings sectional matters should be taken before the reading of a paper on any special subject, the meeting came to an end.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Vice-Chancellor announces that Mr. W. W. Astor has contributed the sum of £10,000 to the University Benefaction Fund.

Mr. F. G. Kenyon, assistant keeper of the manuscripts in the British Museum, has been appointed Sandars Reader in bibliography.

Dr. Haddon, F.R.S., has been appointed University lecturer in ethnology, and Mr. J. J. Lister, F.R.S., to be demonstrator of comparative anatomy.

A University lectureship in experimental physics is vacant by the resignation of Prof. Wilberforce. Applications should reach the Vice-Chancellor by Saturday, November 3.

The portrait of Charles Darwin, now in the Philosophical Library, has been lent for the exhibition of the works of Sir W. B. Richmond, to be held in the New Gallery.

MR. J. A. MCCLELLAND, M.A., has been appointed to the chair of Natural Philosophy in the University College, Dublin, which was rendered vacant by the death of Prof. Preston. Mr. McClelland is a native of North Ireland, and studied physics under Prof. Anderson at Queen's College, Galway. After graduating M.A., he went to Cambridge and continued his studies in physics under Prof. J. J. Thomson, obtaining the B.A. (Research) degree for his original work in the Cavendish Laboratory. In Ireland Mr. McClelland gained an "1837 Exhibition" Science Scholarship, and later a Junior Fellowship of the Royal University of Ireland.

A NOTEWORTHY announcement in the Calendar of University College, Bristol, is that a clinical and bacteriological research laboratory has been established at the college, under the direction of Prof. A. F. Stanley Kent. The value of such a laboratory in a port like that of Bristol cannot be over-estimated, and the City authorities should show their appreciation of it in a practical way. The laboratory will not only provide a means of obtaining trustworthy information and reports upon pathological material, but will also give medical men an opportunity of carrying out bacteriological investigations. Should plague ever appear in Bristol, as it has done at Glasgow, the City authorities will know the value of the laboratory now established at their University College. At present the college does not receive nearly so much local support as some of the other provincial colleges, and there seems to be little hope that there will ever be a West of England University with its centre at Bristol, analogous to the University of Birmingham.

IN the course of her able and suggestive address at the opening of the Passmore Edwards Museum of the Essex Field Club on October 18, the Countess of Warwick made the following statement with respect to local museums:—"I am convinced that museums are destined to play such an important part in education in the future that no town of any importance will be able to be without an institution of this kind. But one of the chief reasons why this part of the club's work has not hitherto been practically realised is because the establishment and maintenance of a museum requires considerable financial resources. However zealous the members of a county natural history society may be, their aims and objects rarely rouse popular enthusiasm to the extent of raising an adequate fund for such purposes. In some counties private munificence had compensated for the lack of public interest. In other cases—and I am glad to be able to quote as an example another Essex town, Colchester—an enlightened Town Council has enabled a local museum to find an appropriate home. And again, in other instances, some of the County Councils have given financial aid from the Technical Instruction Grant, quite a legitimate expenditure as it appears to me, and, if I may express a personal opinion, a most valuable way of assisting in the spread of that knowledge which is the core an essence of all sound scientific education—a knowledge of nature at first hand as distinguished from the knowledge imparted through books or didactically taught in the class-room. But I am afraid that we as a nation have hardly yet risen to that high-water mark of scientific culture which should characterise a great civilisation. I do not mean to imply that we are lacking in scientific ability, that we are devoid of originality, or that we have failed to contribute our share of knowledge to the sum total of human progress. But I fear that the *spirit of modern science* has not sunk into the public mind—it has not permeated the rank and file to that extent which is required by the age in which we live, the century of science *par excellence*. Our purses are ever open, and have always been opened, in the names of charity and philanthropy, religious endowment and missionary enterprise, political organisation and popular sports. But science, upon which the national welfare and our position in the scale of nations ultimately depends, has to go begging for her tens, while thousands are forthcoming for these other objects." These remarks, which were received with loud applause by the audience at West Ham to whom they were addressed, coming from the mouth of a lady who has set such a brilliant example by her pioneering work in rural education, should be productive of good throughout the country. Most cordially will our readers endorse Lady Warwick's sentiments.

SCIENTIFIC SERIALS.

THE *Journal of the Royal Microscopical Society* for October contains a further instalment of Mr. F. W. Millett's paper on recent Foraminifera of the Malay Archipelago; a short article on a new projection eye-piece and an improved polarising eye-piece, by Mr. E. B. Stringer; and the conclusion of Mr. E. M. Nelson's note on the microscopes of Powell, Ross, and Smith, the present instalment dealing with the instruments of

Smith and Beck (now Messrs. R. and J. Beck, Ltd.). In the summary of recent researches in microscopy is an interesting description (with illustrations) of a microscope, with its oculars and objectives, used by Prof. Amici, the discoverer in 1841 of the part played by the pollen-tube in the fertilisation of flowering plants. Nothing could more forcibly illustrate the enormous advance made during the past sixty years in the manufacture of the microscope and its appliances.

Bollettino della Società Sismologica Italiana, vol. vi. 1900–1901, Nos. 2 and 3.—On the necessity and on the choice of comparable seismic apparatus, by A. Cancani (see pp. 395–6).—On the velocity of propagation of the Emilian earthquake of March 4, 1898, by G. Agamennone. The velocity is found to be about 3 km. per second, and it does not vary perceptibly with the distance from the epicentre.—Contribution to the study of the great Neapolitan earthquake of December 1857, by L. Antonio. Contains a copy of a letter written from Caggiano, close to the position assigned by Mallet to the epicentre.—New type of seismometrograph, by G. Agamennone. A reprint of a paper describing an instrument specially designed for registering the very small movements of the ground.—Notices of earthquakes recorded in Italy (March 21 to June 5, 1899), by A. Cancani, the most important being the Greek earthquakes of April 6, 15 and May 3, the Dalmatian earthquake of May 15, and distant earthquakes on March 3, April 2, 12, 13, 16, May 8 and June 5.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 21.—"On the Capacity for Heat of Water between the Freezing and Boiling Points, together with a Determination of the Mechanical Equivalent of Heat in Terms of the International Electrical Units." Experiments by the Continuous-flow Method of Calorimetry performed in the Macdonald Physical Laboratory of McGill University, Montreal. By Howard Turner Barnes, M.A.Sc., D.Sc., Joule Student. Communicated by Prof. H. L. Callendar, F.R.S.

At the Toronto meeting of the British Association in 1897, a new method of calorimetry was proposed by Prof. Callendar and the author for the determination of the specific heat of a liquid in terms of the international electrical units. At the Dover meeting in September, 1899, some of the general results obtained with the method for water over a part of the range between 0° and 100° were communicated, with a general discussion of the bearing of the experiments to the work of other observers. In the present paper the author gives a summary of the complete work, in the case of water, to determine the thermal capacity at different temperatures between the freezing and boiling points.

Theory of the Method.

If a continuous flow of liquid in a tube be made to carry off a continuously supplied quantity of heat EC, in electrical units, then after all temperature conditions have become steady

$$JsQ(\theta_1 - \theta_0)t + (\theta_1 - \theta_0)ht = ECt$$

where

J = mechanical equivalent of heat,
Q = flow of liquid per second,
s = the specific heat of the liquid,
θ_0 = the temperature of the liquid flowing into the tube,
θ_1 = the temperature of the liquid flowing out of the tube,
h = the heat loss per degree rise of temperature from the liquid flowing through,
t = the time of flow.

In the case of water, E represents the E.M.F. across an electrical heating conductor in the tube, and C the current flowing. In this case, which is treated of entirely in the present paper, Js is replaced by $4{\cdot}2\,(1 \pm \delta)$ where δ is a small quantity to be determined, and varies with the thermal capacity of the water, which is not exactly equal to 4·2 joules at all points of the range.

Substituting in the general equation, rearranging terms, and dividing through by t, the equation is given in the following form:—

$$4{\cdot}2Q(\theta_1 - \theta_0)\delta + (\theta_1 - \theta_0)h = EC - 4{\cdot}2Q(\theta_1 - \theta_0),$$

which is termed the general difference equation of the method. The two terms δ and h may be determined by using two values of Q, giving two equations of the form

$$4{\cdot}2Q_1(\theta_1 + \theta_0)\delta_1 + (\theta_1 - \theta_0)h = E_1C_1 - 4{\cdot}2Q_1(\theta_1 - \theta_0)$$
$$4{\cdot}2Q_2(\theta_2 - \theta_0)\delta_2 + (\theta_2 - \theta_0)h = E_2C_2 - 4{\cdot}2Q_2(\theta_2 - \theta_0).$$

For the same value of θ_0, if the electrical supply for the two flows is regulated so that $\theta_1 = \theta_2$, then $\delta_1 = \delta_2 = \delta$, and by eliminating h,

$$\delta = \frac{(E_1C_1 - 4{\cdot}2Q_1(\theta_1 - \theta_0)) - (E_2C_2 - 4{\cdot}2Q_2(\theta_1 - \theta_0))}{4{\cdot}2(Q_1 - Q_2)(\theta_1 - \theta_0)}$$

which corresponds to the mean temperature

$$\theta_0 + \frac{\theta_1 - \theta_0}{2},$$

where $(\theta_1 - \theta_0)$ is not too great.

In the present method the flow tube is of glass, about 2 mm. in diameter, connected to two larger tubes forming an inflow and an outflow tube, in which the temperature of the water is read, by a differential pair of platinum thermometers, before and after being heated by the electric current. A glass vacuum jacket surrounds the fine flow tube and a part of the inflow and outflow tubes, to reduce the heat loss as much as possible. A copper water jacket encloses the inflow tubes and vacuum jacket, in order to maintain the glass surface of the vacuum jacket always at a constant temperature equal to the inflowing water. The heat loss from the water is then the loss due to radiation from the flow tube through the vacuum jacket, and conduction from the ends of the flow tubes.

In testing the accuracy of the method, the dependence of the heat loss on the rise of temperature was found, and the dependence of the heat loss on the flow.

The results with different calorimeters and with different rises of temperature are given in the following table:—

Summary of the Specific Heat of Water from Smoothed Curve.

Temperature C.	δ	J.
5	+0·00250	4·2105
10	−0·00050	4·1979
15	−0·00250	4·1895
20	−0·00385	4·1838
25	−0·00474	4·1801
30	−0·00523	4·1780
35	−0·00545	4·1773
40	−0·00545	4·1773
45	−0·00520	4·1782
50	−0·00480	4·1798
55	−0·00430	4·1819
60	−0·00370	4·1845
65	−0·00310	4·1870
70	−0·00245	4·1898
75	−0·00180	4·1925
80	−0·00114	4·1954
85	−0·00043	4·1982
90	+0·00025	4·2010
95	+0·00090	4·2038
	Mean value	4·18876

The values of δ represent the specific heat of water in terms of a thermal unit equal to 4·2000 joules, which occurs at 9° C. It is more suitable to select a thermal unit at a more convenient part of the scale. The mean value of the mechanical equivalent of heat from these measurements over the whole range is 4·18876 joules, which is very nearly equal to the value at 16° C., which is 4·1883 joules. It seems desirable to select a unit at a temperature which, if at the same time at a convenient part of the scale, may be equal to the mean value over the whole scale. The author has in consequence adopted a unit at 16° C., and has expressed the specific heat of water in terms of this unit.

Two formulæ can be fitted very accurately over the scale. Between 5° and 37·5° C. the following expression in terms of a thermal unit at 16° is found to read,

$$S = 0{\cdot}99733 + 0{\cdot}0000035\,(37{\cdot}5 - t)^2 + 0{\cdot}00000010\,(37{\cdot}5 - t^3).$$

The same formula holds between 37·5° and 55° by simply considering all values of the cubical term positive. Above 55° the simple formula

$$S = 0{\cdot}99850 + 0{\cdot}000120(t - 55°) + 0{\cdot}00000025(t - 55)^2$$

holds with great accuracy.

Physical Society, October 26.—Dr. Lodge, President, in the chair.—The chairman read a letter from Prof. Cleveland Abbe, of the United States Coast and Geodetic Survey, stating that the *Monthly Weather Review* would be sent regularly to any member of the Physical Society expressing a wish to receive

it. On the other hand, the Chief of the Weather Bureau would at any time be glad to receive communications referring to the physics of the atmosphere.—Dr. Shelford Bidwell then exhibited some experiments illustrating phenomena of vision. The first phenomenon illustrated was that known as "Recurrent Vision." A vacuum tube, illuminated by an induction coil, was made to rotate about a horizontal axis, and was seen to be followed, at an angle of about forty degrees, by a feebly luminous reproduction of itself. A spot of white light, projected upon a screen, and caused to move slowly in a circular path, was also followed by a less luminous spot. The same effect was shown by spots of green and yellow light, but in the case of red light no ghost was visible. The phenomena of recurrent vision are due principally, if not entirely, to the action of violet nerve fibres. The next experiments related to the non-achromatism of the eye. The lenses of the eye do not constitute an achromatic combination, although under ordinary conditions a bright object is not surrounded by fringes of colour. The effects of chromatic aberration are disguised by the luminous haze which surrounds the object, produced by a defect in the eye regarded as an optical instrument. A six-rayed star, formed by cutting a hole in an opaque screen, was illuminated by a gauze-covered condenser containing an incandescent lamp. The star was fairly clearly defined, and there were no fringes. More attentive observation showed a luminous haze. This haze is formed in consequence of the cellular structure of the eye, and the brightest rays—orange, yellow and green—are chiefly instrumental in forming it. If, therefore, these rays are obstructed, the conditions are more favourable for the observation of chromatic aberration. The rays were consequently cut off by means of coloured glasses, and the general hue of the star was purple; to some it appeared bordered with dark blue, while to others (long-sighted) it appeared bordered with red. Two oblong patches, one red and the other blue-violet, and of approximately the same intensity, were then produced side by side upon a screen. An observer with very good eyesight was able, at a distance of ten feet, to focus the patches alternately with perfect distinctness. In general, the blue patch was said to be more or less blurred. With an achromatic eye it should be possible to focus both together. Dr. Bidwell then showed some lantern slides, illustrating the complex form seen when viewing a small luminous spot through a gauze-covered lens placed so as not to be in exact focus. Some experiments were performed illustrating the principle of the colour top. When a bright image is formed on the retina after a period of darkness it has, in general, a red border which lasts for a fraction of a second. A dark patch suddenly formed on a bright ground has a blue border which lasts for a similar time. These effects were attributed by Dr. Bidwell to a sympathetic action of the red nerve fibres. When the various nerve fibres occupying a limited portion of the retina are stimulated by ordinary white or yellow light, the immediately surrounding red nerve fibres are for a short period excited sympathetically, while the violet or blue and green fibres are not so excited, or in a much less degree. Again, when light is suddenly cut off from a patch in a bright field, there occurs a sympathetic insensitive reaction in the red fibres just outside the darkened patch, in virtue of which they cease for a moment to respond to the luminous stimulus; the green and violet fibres by continuing to respond uninterruptedly give rise to the sensation of a blue border. By a simple experiment it was shown that the explanation of the colour top, depending upon changes in the convexity of the eye and non-achromatism, was untenable. By the use of a strong light it is possible to get negative after-images after looking at a brightly-coloured object. These images are complementary in colour to the object, and are formed even if the object is only viewed for a fraction of a second. By means of proper illumination and a disc rotating at the proper speed, a red wafer was so arranged that, upon looking at it, it was impossible to recognise the wafer itself, but only the continuous green after-image. The Chairman expressed his interest in the last experiment, in which it was possible to see the negative after-image of an object and not the object itself. Prof. S. P. Thompson said these experiments threw a doubt on some of the accepted notions about the properties of the eye. Dr. Bidwell asks us to believe that the yellow haze is due to a cellular structure in the eye. Is there such a structure? Can it be observed with a microscope? And do its meshes correspond in magnitude with those necessary to produce the effects? By diminishing the size of the pupil the haze is diminished and the sharpness of the image is increased. The effects seem to be due to ordinary aberration. Prof. Thompson said that the achromatism of the eye was simply shown by covering half the object-glass of a telescope and viewing a bright object with it. The object then seems bordered with coloured fringes. Mr. Blakesley, referring to the colour patches used by Dr. Bidwell, pointed out that although the patches were the same distance from the lens, yet they did not possess the same magnification. The last experiment shown did away with the theory of persistence of vision, because the space between the object and the negative after-image was evidently not illuminated. Mr. Trotter asked if red and green were the only colours which gave complementary negative after-images. Dr. Bidwell, in reply, said the effect was obtainable throughout the length of the spectrum.—A paper on the concentration at the electrodes in a solution, with special reference to the liberation of hydrogen by electrolysis of a mixture of copper sulphate and sulphuric acid, was read by Dr. H. J. S. Sand. In this paper an equation has been derived for calculating the concentration at the electrode of a solution of a single salt from which the metal is being deposited under the conditions (1) that the solution is contained in a cylindrical vessel bounded by the electrodes, (2) that no convection-currents occur, and (3) that the diffusion of the salt obeys Fick's law, and its transport values are constant. This formula can be made the basis for roughly determining diffusion coefficients. In the case of mixtures, it is possible to arrive at limits for the concentration, and it has been experimentally proved that hydrogen always appears at the electrode of an acid solution of copper sulphate, in which no currents of liquid are taking place, between the limits of time for the concentration to go down to zero. The time which it takes for the hydrogen to appear can be calculated from an empirical formula, which is similar in form to the one used for a single salt. The great part played by convection-currents in determining the ratio of the two constituents given off at the electrode of an acid copper-sulphate solution, has been shown by proving experimentally that artificial stirring causes hydrogen to disappear altogether in cases where it would otherwise have presented over sixty per cent. of the equivalents carrying the current from the solution to the electrode. The Chairman drew attention to the fact that no hydrogen was liberated until all the copper had gone, and said the formula for the concentration might be used again in further investigations. Dr. Donnan asked if the time at which hydrogen was liberated had been taken as the time at which hydrogen actually made its appearance in the form of bubbles, or whether any allowance had been made for saturation. Dr. Sand said the time was taken up to the appearance of bubbles.—A paper by Dr. R. A. Lehfeldt on electromotive force and osmotic pressure was postponed until the next meeting. The meeting then adjourned until November 9.

PARIS.

Academy of Sciences, October 22.—M. Maurice Lévy in the chair.—On the convergence of meridians, by M. Hatt.—Diagnosis of gaseous supersaturation in cases of a physical order and chemical order, by M. Berthelot. A description is given of attempts made to distinguish between these two classes of phenomena by means of the calorimeter, the reactions studied being the decomposition of dilute solutions of hydrogen peroxide by addition of platinum black or of potassium permanganate. From experiments with the latter reagent, the conclusion is drawn that the considerable quantities of oxygen held in solution are held in the state of an unstable chemical compound.—The origin of atmospheric hydrogen, by M. Armand Gautier. It has been shown in previous papers that air normally contains about ·02 per cent. of free hydrogen. It has been shown that, besides being a normal product of some putrefactive fermentations, hydrogen is given off by many volcanoes, and also escapes from many mineral springs. It is found that certain granites treated *in vacuo* with phosphoric acid give about from three to four times their volume of free hydrogen. Since ammonia is always produced at the same time, the surmise is put forward that nitride of iron, Fe_8N_2, is the source of these two gases. This nitride has not been isolated from these granites, but iron nitrides have been found in the crystalline deposits of the lava fissures of Etna by Silvestri.—Observations on the development of the Onychophoræ, by M. E. L. Bouvier. The species, *Peripatopsis Sedgwicki*, is distinguished from other species of the same genus by the nutritive blastodermic vescicle on the head of its embryos, and by the different stages of the embryo found in the same female,

These facts have already been shortly noticed, but fuller details are given in the present paper.—On the topographical correction of pendulum observations, by M. J. Callet. The method suggested has been worked out for two stations, La Bérarde and Lautaret, situated in the centre of the Alps. The application of the corrections is tedious and lengthy, but the errors of the results obtained are of the same order as those inherent in the pendulum observations themselves under favourable conditions.—Observations of the Perseids, made at Athens, by M. D. Eginitis. The observations were carried out between August 5 and August 12. The meteors were of a reddish-yellow colour, of about the 5th magnitude, and possessed a large number of radiant points.—First results of researches on the recognition of the solar corona at other times than during a total eclipse by means of the calorific rays, by M. H. Deslandres. The possibility of detecting the corona with the aid of a thermo-couple having been proved during the recent total eclipse, daily observations with the same apparatus have since then been carried out at Meudon. The results, although incomplete, show that the presence of the corona can be clearly detected under ordinary conditions in this way. The observations will be continued with more sensitive apparatus.—On the convergence of the coefficients in the development of the perturbation function, by M. A. Féraud.—On the intrinsic equations of motion of a wire, and the calculation of its tension, by M. G. Floquet.—On orthogonal systems admitting a continuous group of transformations of Combescure, by M. D. Th. Egorou.—Index of refraction of bromine, by M. Ch. Rivière. The index of refraction of carefully purified bromine has been determined for temperatures between 10° and 25° for wave-lengths between 790·9 $\mu\mu$ and 592·5 $\mu\mu$, and show that bromine has very great dispersive power, that for rays between A and D at 20° being ·037, compared with ·030 for carbon bisulphide.—The law of moduli. Thermochemical moduli, by M. A. Ponsot.—On the ammoniacal arseniates of cobalt, by M. O. Ducru. The existence of three distinct salts is indicated, which can be distinguished by the pressures at which ammonia commences to be given off.—On a general method of preparation of mixed carbonates of phenols and alcohols, and on the properties of some of these esters, by M. E. Barral. Of the various methods proposed for the preparation of these mixed esters, the best results are obtained by the action of carbonyl chloride upon a solution of the phenol in alcoholic potash or soda, the reagents being all employed in molecular proportions.—Stereochemistry of nitrogen. The stereoisomeric hydrazones of ethyl pyruvate, by M. L. J. Simon. The two isomeric hydrazones are obtained simultaneously, but in unequal quantities. They differ considerably in melting points and solubilities.—Acetals of monovalent alcohols, by M. Marcel Delépine. A thermochemical paper.—On direct nitration in the fatty series, by MM. L. Bouveault and Wahl.—Partial synthesis of laudanosine, by MM. Amé Pictet and B. Athanesesco.—On the pollinisation of cleistogamous flowers, by M. Leclerc du Sablon.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 1.

CHEMICAL SOCIETY, at 8.—Dehydrohomocamphoric Acid and its Oxidation Products: Arthur Lapworth.—Derivatives of Ethyl α-methyl-β-phenylcyanglutarate: W. Carter and W. Trevor Lawrence.—The Nitration of Acetamino-o-phenylacetate (diacetyl-o-aminophenol)—a Correction: R. Meldola, F.R.S., and Elkan Wechsler.—Rhamnazin and Rhamnetin: A. G. Perkin and J. R. Allison.—(1) Luteolin, Part III.; (2) Genistein, Part II.: A. G. Perkin and L. H. Horsfall.—Colouring Matter of the Flowers of *Delphinium consolida*: A. G. Perkin and E. J. Wilkinson.—The Action of Alkalis on the Nitro-compounds of the Paraffin Series. Part II.: Wyndham R. Dunstan, F.R.S., and Ernest Goulding.—Hexachlorides of Benzonitrile, Benzamide and Benzoic Acid: F. E. Matthews.—The Influence of Solvents on the Rotation of Optically-active Compounds, Part I.: T. S. Patterson.—Note on Gallinek's Amidomethylnaphthimidazole: R. Meldola, F.R.S., and F. H. Streatfeild.—The Action of Heat on Ethyl-Sulphuric Acid: W. Ramsay and G. Rudorf.—The Amount of Chlorine in Rain-water collected at Cirencester: Edward Kinch.

RÖNTGEN SOCIETY, at 8.—Presidential Address: Dr. J. B. Macintyre.

FRIDAY, NOVEMBER 2.

GEOLOGISTS' ASSOCIATION, at 8.—Conversazione, with Exhibits of Objects and Photographs.

MONDAY, NOVEMBER 5.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Preliminary Examination of Applications for Patents: W. Lloyd Wise.—The Early Manufacture of Sulphuric and Nitric Acids: Oscar Guttmann.

TUESDAY, NOVEMBER 6.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Address by the President, Mr. James Mansergh, and presentation of medals and prizes awarded by the Council.

WEDNESDAY, NOVEMBER 7.

GEOLOGICAL SOCIETY, at 8.—Additional Notes on the Drifts of the Baltic Coast of Germany: Prof. T. G. Bonney, F.R.S., and the Rev. Edwin Hill.—On certain Altered Rocks from near Bastogne, and their Relations to others in the District: Dr. Catherine A. Raisin.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Determination of the Available Brewing Extract of Malt: Lawrence Briant.—The Definition of the Genuine Product: C. E. Cassal.—Notes on certain B.P. Tests: C. G. Moor and Martin Priest.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 8.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—On the Transmission of Force through a Solid: Lord Kelvin, G.C.V.O.—In a Simple Group of an Odd Composite Order every System of Conjugate Operators or Sub-groups includes more than Fifty: Dr. G. A. Miller.—Prime Functions on a Riemann Surface: Prof. A. C. Dixon. (i) Further Note on Isoscelians; (ii) On Two In-triangles which are similar to the Pedal Triangle: R. Tucker.—(i) A General Congruence Theorem relating to the Bernoullian Function; (ii) On the Residues of Bernoullian Functions for a Prime Modulus, including as Special Cases the Residues of the Eulerian Numbers and the I-numbers: Dr. Glaisher, F.R.S.—On Green's Function for a Circular Disc: H. S. Carslaw.—On the Real Points of Inflexion of a Curve: A. B. Basset, F.R.S.—On Quantitative Substitutional Analysis: A. Young.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address: Prof. J. Perry, F.R.S.

FRIDAY, NOVEMBER 9.

ROYAL ASTRONOMICAL SOCIETY, at 8.

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Fig. 1

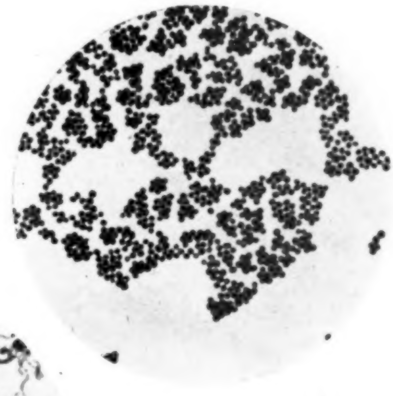
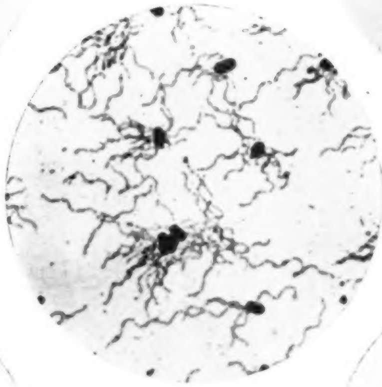


Fig. 2



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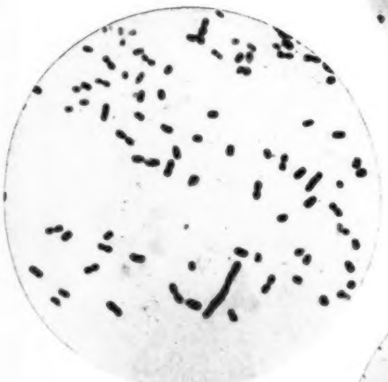

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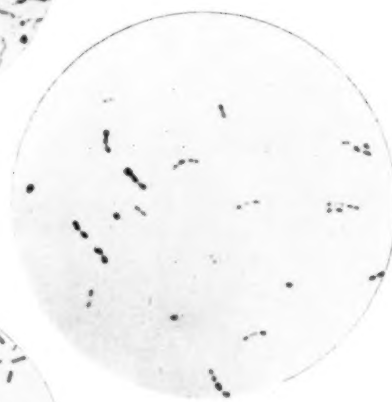

Fig. 4

Fig. 8

Fig. 5

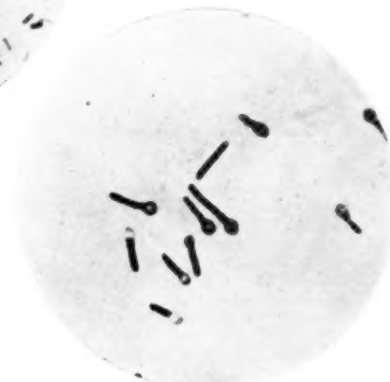

Fig. 6

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